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Improving coastal management outcomes through science and the law

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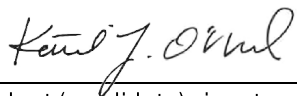
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Improving Coastal Management Outcomes Through Science and the Law

***A thesis submitted in partial fulfilment of the
requirements for the award of the degree**

**Master of Environmental Science (Research)
from
UNIVERSITY OF WOLLONGONG**

By

Katie J. O'Neal, Bachelor of Science

School of Geography and Sustainable Communities

2016

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Abstract

The conservation of coastal resources and environmental values for current and future generations is challenged by pressure for development in vulnerable coastal locations. Science and the law each provide important contributions to addressing how development is approved on the coast. Coastal decision makers accept that science is crucial for management, providing knowledge about habitats, physical processes and predicted responses to change. Yet, there are many challenges associated with applying science to management decisions. A growing body of scientific research investigates the barriers occurring within environmental governance networks to identify ways to improve the application of science, referred to as 'science uptake'. The key message from existing research is that improved communication is necessary to overcome science uptake barriers, particularly between scientists, coastal managers, policy-makers, and the local community. One aspect of science uptake that has received relatively little attention in the literature is the role played by the law; this thesis addresses that gap. The law is considered in this thesis to be significant to science uptake because it guides and limits the work of coastal decision makers, including how science is used in decisions impacting the coastal zone.

This thesis addresses the role of the law in the uptake of science within coastal management, through a case study of the south coast of New South Wales (NSW), Australia. In particular, it focuses on the experience of four local councils in this region: Wollongong City Council, Shoalhaven City Council, Eurobodalla Shire Council, and Bega Valley Shire Council. Local councils were chosen for interviews because they have a major influence on how the coast is managed due to their responsibilities in land use planning and development consent. The ways in which the law enables science to be used in coastal management are investigated through an interdisciplinary literature review and analysis of legislation and case law. Attendance at various meetings, conferences and workshops for coastal scientists and local government, contributed to an evaluation of the key legal and scientific issues impacting coastal management. The roles of local councils in coastal management, and the legal and scientific challenges impacting their work, were explored through semi-structured interviews with representatives from the four councils. Key themes and challenges from the interview data are evaluated to identify potential legal improvements to enable councils to better manage the coasts.

Managing the risk of coastal hazard and climate change impacts on existing and proposed development is a major challenge faced by local councils on the south coast. In particular, there is significant concern among councils about coastal inundation; however, a lack of community awareness and acceptance of inundation risk presents a barrier for councils to manage the risk in light of current science. Addressing community concerns about the management approaches taken by councils in the coastal zone is a challenging aspect of councils' work; local councils need better resources and techniques for engaging with the public. Based on the thesis finding that the remote council, Bega Valley, does not yet face the development problems occurring in the more developed councils, this thesis recommends that planning laws in NSW should consider future development and population growth in remote regions to avoid adverse development consequences. This thesis illustrates barriers in the law that impede climate change adaptation and create liability risk and legal uncertainty for councils regarding sea level rise planning. Councils need a strong legal framework that enables them to address scientific uncertainty regarding future environmental changes to the coast.

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Chapter 1: Introduction

1.1 Science, the law and coastal management

It has been widely recognised that connections between science and coastal management could be strengthened, improving the capacity for decision-making in light of scientific understandings of the coast (Bultitude et al., 2012; Cash et al., 2002; Cash et al., 2006; Vogel et al., 2007). An important component of improving the use of science in coastal management decisions is the role of the law in determining how science is used. This has received little attention within the literature. Legislation can set out a range of coastal planning and management approaches, such as land zoning, development control, strategic planning and requirements for coastal protection works. These are generally implemented through actions of local government. The design of these mechanisms can enable knowledge of coastal environments and processes to be applied to decisions; thus law and policy may play a key role in determining the scientific basis of coastal management decisions.

This thesis aims to address the gap in the literature through an investigation of legal requirements for science-based decision-making in New South Wales (NSW), Australia. The project is based on case studies of local councils on the south coast of NSW, investigating how science is applied to coastal management issues through legal instruments. This project was undertaken in a time of great change to the laws and policies for coastal management in NSW. These legal and policy changes, and the influence of change on councils' work, are topical factors in this thesis. The results of this thesis will help to illustrate the need of local government for a supportive legal framework that enables the application of the best available science to coastal management decisions while providing a legal basis for their decisions. This thesis concludes with an assessment of issues or constraints existing within the law and provides recommendations for how science can be better incorporated into the NSW coastal regulatory framework to achieve improved environmental outcomes.

1.2 Aims and Objectives

The first aim of this thesis is to consider how science is applied to coastal management decisions through the law. This is approached through analysis of NSW regulations and

case law relevant to the coast in order to evaluate the legal basis for the application of science in coastal management and any issues related to coastal law in NSW. The objective was to gain an understanding of the current legal setting as necessary background for the second aim of this study.

The second aim of this thesis is to identify how science can be better incorporated into the NSW coastal regulatory framework to achieve improved environmental outcomes. This was approached by qualitative research methods applied to explore the use and influence of science and the law in local councils' management of the coast. Interviews were undertaken with the following four local councils on the south coast of NSW: Wollongong City Council, Shoalhaven City Council, Eurobodalla Shire Council, and Bega Valley Shire Council. The interviews are analysed to achieve the following four objectives:

- a) Investigate local councils' roles and the major issues faced in managing the coast;
- b) Investigate how science is applied to coastal management through the work of councils;
- c) Investigate the role of law in local councils' management of the coast; in particular, the ways in which the law either enables or limits science based management to be carried out by local government;
- d) Evaluate how aspects of the NSW legal framework might be adjusted to improve protection and conservation of coastal resources.

Through these objectives this study seeks to understand the governance and legal barriers faced by NSW south coast councils, in order to identify legal improvements that could better promote the protection and conservation of the coast. The thesis makes recommendations regarding changes to the law and governance processes; in particular pertaining to the incorporation of science.

1.3 Background

This section introduces the key elements of the study, being coastal management and the roles of science and local councils within the context of managing coastal

environments. The relevance and influence of the law within these elements will be highlighted.

1.3.1 Coastal Management

In order to investigate how coastal management may be improved through the use of science and the law, it is first necessary to review the role and characteristics of coastal management programs. This section discusses coastal management approaches and concepts developed at the global scale that have influenced how coasts are managed in Australia. The key coastal management issues relevant to this thesis are introduced.

Coastal management can be broadly defined as the various land use planning and environmental management techniques enacted upon a coastline (Kay and Alder, 2005). Such programs have traditionally dealt with issues related to the landward side of the ocean, including shoreline erosion, decisions on coastal development, maintaining public access to beaches, and protection of coastal habitats (Cicin-Sain and Knecht, 1998). Early coastal management largely occurred through independent operations in disciplines including regional development planning, resources conservation and watershed management (Clark, 1996). In effect, decisions made about the coasts occurred as separate entities with little consideration of the large-scale interactions occurring within coastal, marine and terrestrial systems. The need for integrated natural resource management, in which all relevant decision makers acted under common goals and policies, has been promoted globally through various United Nations programs and documents since the 1970's (United Nations, 1972; Bruntland, 1987; United Nations, 1992). New ways of managing water resources, forests, agricultural land, oceans and the coast were recognised as crucial for the social and economic well-being of communities. Integrated management of coastal and marine environments in particular has been addressed by the United Nations Environment Programme (UNEP) Regional Seas Program since 1975 and within the Rio Declaration 1992 through which participants committed to integrated management of their coast and marine resources (Kenchington and Crawford, 1993).

An important component of achieving integrated management is a framework of policy and legislation to delegate authority and provide guidance to coastal decision makers.

The World Commission on Environment and Development's report 'Our Common Future' (Bruntland, 1987) highlighted the need for changes to occur within the institutions and legal frameworks involved in managing natural resources. The following statement from the report describes the relevance of making institutional and legal changes to improve environmental management:

The integrated and interdependent nature of the new challenges and issues contrasts sharply with the nature of the institutions that exist today. These institutions tend to be independent, fragmented, and working to relatively narrow mandates with closed decision processes. Those responsible for managing natural resources and protecting the environment are institutionally separated from those responsible for managing the economy. The real world of interlocked economic and ecological systems will not change; therefore the policies and institutions concerned must (Bruntland, 1987, pg. I.1.10).

This statement reveals several issues existing within coastal management that are relevant to this thesis. First, there is an identified need for policy reform, giving relevance to this thesis' aim to consider legal constraints to managing coastal environments. Second, the multiple institutions involved in governing coasts are key challenges discussed in contemporary coastal management literature; this thesis will investigate governance issues impacting coastal management at the local government level.

The role of institutional and legal reform in coast and ocean management has been described in relation to the various holistic management regimes that have developed, such as Integrated Coastal Zone Management (ICZM) (also referred to as Integrated Coastal Management - ICM). These approaches have developed in response to the global setting of integrated management of resources. In the coastal policy development cycle undertaken by federal and state government institutions, the law is used to formalise policy (Olsen et al., 1997). In this way, the law supports ICZM programs by enabling policy implementation through delegation of responsibility for particular actions (Bates, 2013). The concept of integrated management has been greatly influential on coastal management programs throughout the world (Nobre, 2011; Sorensen, 1997), and has been attributed as one of the major drivers to changes

in coastal management programs and legislation in Australia during the late 20th century (Thom and Harvey, 2000).

There are a range of issues connected to managing the coast; however development and the impact of coastal hazards and climate change are two aspects of coastal management that have emerged as particularly relevant to this study of the law and local councils. Addressing coastal hazard and climate change impacts on the coast, particularly managing risks to coastal development, are current topics of concern in the work of local councils. These issues have emerged from this study's interviews, participant observation at meetings and conferences for coastal professionals in Australia, and through review of coastal legislation and policy, coastal management programs and documents, and NSW case law. A major role of legislation for the coastal zone is to manage the interactions between development and coastal environments so neither is negatively impacted (*NSW Coastal Protection Act 1979, NSW Planning and Assessment Act 1979*). Furthermore, the decisions local councils make about coastal development and planning for climate change are central to many legal challenges surrounding coastal management.

The first key coastal management issue addressed in this thesis is the impact of coastal hazards and climate change on coastal environments and communities. A range of coastal hazards impact the NSW coastline, including beach erosion, coastal inundation, shoreline recession, coastal entrance behaviour, slope and cliff instability, stormwater erosion and sand drift (NSW Government, 1990). Climate change impacts, such as sea level rise, changes to storm frequency and intensity, and altered precipitation patterns, directly influence coastal habitats and may increase the impacts of coastal hazards on populated shorelines (Woodroffe et al., 2012). Climate change is a major focus in coastal policy and legislation and related discussions, particularly concerning coastal planning issues with future impacts including sea level rise. Climate change has been a central influence on reforms occurring in Australia's coastal management in the past 25 years, evident in the strategies and policies adopted by federal, state and local levels of government. International attention turned to global climate change and the principles of ecologically sustainable development (ESD), particularly with the United Nations (UN) Brundtland Report in 1987 and the first report of the Intergovernmental Panel on Climate Change (IPCC) in 1990. Addressing climate change is considered an integral

component of ESD, particularly in relation to the principle of intergenerational equity, which promotes making decisions today that will not disadvantage future generations (Bruntland, 1987). These reports gave motivation for extensive reviews of Australia's coastal management in the early 1990's (Thom and Harvey, 2000). An inquiry into coastal management by the Australian Resource Assessment Commission (RAC, 1993) provided recommendations that were incorporated into climate change policies and strategies by the Commonwealth and state governments, including legislation by several states (Thom and Harvey, 2000). Climate change has continued to be a major focus of coastal management in Australia, addressed for example by recent Commonwealth inquiries and reports (CoA, 2009; CoA, 2011; HoR, 2009) and a national research program to address climate change pressures led by the National Climate Change Adaptation Research Facility (NCCARF). Various national organisations are also dedicated to improving coastal management, such as The Australian Coastal Councils Association (previously known as the National Seachange Taskforce) and the Australian Coastal Society.

The second key coastal management issue investigated in this thesis is coastal development. Development and poor planning have been recognized as a threat to the health of Australia's coastal ecosystems and resources in various federal reviews since 1980 when the first review of coastal management was undertaken (HoR, 1980). The issue of managing development is particularly relevant in the context of climate change, with a recent parliamentary inquiry into climate change and environmental impacts on coastal communities pointing to a need to reconsider the way in which development is approved on the coast (HoR, 2009). The coasts of Australia are sought after residential locations, with approximately 80% of the population living within 50 kilometres of the coast (SOE, 2011). Moreover, many coastal communities have experienced rapid population growth over many decades, associated with migration to the coast for social and economic reasons, termed the 'sea change' phenomenon (Burnley and Murphy, 2004). The statistics for population growth in Australia show that coastal regions, particularly along the eastern coast, generally experience the highest growth rates outside of capital cities (ABS, 2007; ABS, 2014).

The continued urbanisation of coastal environments and associated need for houses, infrastructure and facilities puts a major strain on coastal and marine environments,

particularly impacting biodiversity and water quality through loss of habitat and urban pollution (SOE, 2011). There is high development pressure on the coast as well as a legacy of past development. Rapid expansion of coastal communities in NSW during the 1970s-80s was made possible due to the availability of large areas of land which were less expensive relative to metropolitan areas, enhanced by a pro-development attitude taken by many local councils to attract population and ratepayers (Sant and Simons, 1993). As a result, low density development occurred in patches along the coast of NSW; some new development occurred as an extension of existing settlements, but much occurred on land that was previously undisturbed coastal habitat (Sant and Simons, 1993).

1.3.2 Science

This section introduces the significance of the application of science to coastal management, explaining why it is important, the types of science that help to address coastal issues, and why the application of science to management presents a challenge.

Science is accepted by coastal managers and scientists as an essential component to managing complex environmental systems and the various issues associated with human use of coastal environments (GESAMP, 1996; Nobre, 2011; Lester et al., 2010). In addressing coastal management issues it is particularly important to integrate biophysical sciences to understand the coastal system, and social sciences to understand the social structures and processes that determine the governance of the coast and the human dependencies and impacts on the coast. An approach that incorporates the various scientific disciplines important to coastal management is one objective of Integrated Coastal Zone Management (ICZM) (Cicin-Sain and Knecht, 1998; Sorensen, 1997), and reflected in other holistic management strategies. For example, the emphasis of ecosystem-based management (EBM) on use of current accepted knowledge about a given ecosystem, including cumulative impacts and connections to other ecosystems (UNEP, 2011), points to the need for applying science from a range of disciplines to the management regime for that ecosystem.

The key purpose of research tools in the context of management is to provide information for planning and decision-making (Nobre, 2011). Science is applied to

coastal problems at various stages within the management cycles associated with coastal management regimes. Coastal management programs are carried out as an adaptive management cycle which typically includes: identifying priority issues; defining policy through management objectives, strategies and action; adoption of the plan through law or other formal agreement; carrying out the policy actions; and lastly, program evaluation to determine effectiveness and assessment of goals (Olsen et al., 1997). In a report by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection entitled 'The Contribution of Science to Integrated Coastal Management,' biophysical science is described as particularly important in the ICM cycle of management for initial assessment of the coastal environment to determine its condition and the relevant management issues (GESAMP, 1996). These findings help to inform the planning stage of coastal management programs. Science also plays a key role in monitoring the impacts of the program on the environment and overall program evaluation.

Biophysical science is imperative to coastal management as it provides coastal managers with knowledge to utilise for planning and risk management decisions. For example, science provides knowledge about the characteristics and dynamics of coastal sediments, the interconnected nature of coastal processes and resultant form and function of coastal environments (Short and Woodroffe, 2009). Knowledge of coastal processes and resilience supported by data and monitoring, aid in designing appropriate management strategies allowing for sustainable management of coastal erosion, an important issue for developed coastlines (Marchand et al., 2011). Vulnerability and impact studies are informed by science, providing knowledge of potential impacts on the biophysical environment and the ability of a system to deal with changes; such studies are used in coastal management through applications such as biodiversity conservation strategies (McGinnis and McGinnis, 2011), and risk assessment of economically valuable species and industries that depend on high environmental quality, such as the NSW oyster industry (Leith and Haward, 2010). Climate science and modelling provide knowledge of earth processes and future climate and sea level scenarios (Nicholls et al., 2007). Projections about conditions on the coast are applied to councils' land use planning and development consent; the use of climate science is essential for councils to mitigate the risk of coastal hazard impacts on their communities now and in to the future (IPCC, 2012).

Despite the importance of scientific research to coastal management, the literature points out that the application of science to decision-making, or science uptake, is often poor (Cash et al., 2002; Cash et al., 2006; Vogel et al., 2007; Bultitude et al., 2012). This thesis aims to provide insight into the science uptake problem through its investigation into legal and governance issues impacting the application of science to coastal management. The issues associated with this problem will be explored in the literature review in chapter 3.

1.3.3 Local councils

In Australia, councils are the predominant decision makers regarding development on the coastline. Development decisions occur through councils' strategic and local development planning, and determining the outcomes of development applications (Harvey and Caton, 2010). Local government is largely responsible for turning state coastal and planning policy into actions (SCCG & NSW EDO, 2008; NSW Government - Department of Climate Change & Energy Efficiency, 2012), occurring through councils' legislated responsibilities. One of the key tasks local councils have in managing the coast involves planning, control and assessment of new development in the coastal zone. This section describes the key responsibilities of local councils in coastal management, highlighting councils' influential role in decisions made about the coast. This influence, combined with the complex issues councils face in managing their coastlines, provides the rationale for this study's approach of investigating local councils to understand ways in which the law and application of science can be improved.

A major concern for coastal councils across Australia is managing the pressures of population growth, including changes to the local environment and socio-economic characteristics of their communities (Gurran et al., 2005). The planning and development decisions councils make occur under a framework of relevant legislation and policy (see chapter 4.1); thus law and policy are important determinants of the pattern of development that occurs on the coast. The design of law and policy are integral to protecting coastal habitats and managing the risk of coastal hazards. The responsibilities of local government are significant to environmental outcomes in the coastal zone, as these planning and development decisions ultimately determine the

type and placement of development on the coast. If made poorly, decisions can lead to unsustainable development and severe degradation of coastal habitats and ecosystems.

Councils have a duty of care to make decisions that minimise the risk of coastal hazards on their communities. Implicit to coastal planning and development assessment is consideration of the impacts of coastal processes including climate change factors, particularly coastal inundation and sea level rise. Requirements for consideration of coastal hazards and climate change impacts are provided through state legislation and policy. Addressing the risks posed by climate change is a major priority of the work of local councils in managing the coast; this point is evident from the interviews and participant observation at meetings and conferences. Furthermore, a key aspect of addressing climate change risks is managing development in the coastal zone.

In their coastal management programs, particularly in creating a coastal zone management plan (CZMP), the studies undertaken by local councils have a major focus on assessing and managing climate change risk to coastal development now and into the future. Implementing climate change policies in land use planning and development is imperative for keeping people and the built environment safe from coastal hazards, and for minimising impacts on coastal environments. The legal delegation of authority to councils as the prime decision makers about coastal land use planning, development assessment and management of environmental issues in their local area, makes them integral to implementing state policy on climate change.

A key aspect of councils' coastal management programs is the development and implementation of management plans. While CZMPs are a major aspect of councils' coastal management programs, other types of management plans may be used to address particular needs of that council; for example the management of estuaries, flood risk or dune vegetation. Management plan development is typically a lengthy process, involving preliminary studies to assess environmental and socio-economic factors, making a draft plan, involving the community through consultation processes, through to legally required formal adoption by the council and acceptance by the NSW Minister for the Environment. As preparation for implementation, councils develop policy and strategic projects in order to implement management actions to give effect to the CZMP. The activities that councils may undertake within strategic projects include

dune re-vegetation and maintenance, estuary entrance management, remediation plans for beach erosion, and maintaining existing coastal protection. Councils are also generally responsible for managing public coastal land reserves, maintaining coastal access points and signage, keeping the beaches clean and maintaining public assets. Managing public coastal infrastructure, such as surf lifesaving clubs and other buildings, bike tracks, playing fields, roads, playgrounds and ocean pools, and issues associated with coastal erosion and inundation affecting these assets, is a significant concern for councils (Rollason, 2012).

1.4 Thesis Outline

This section provides an explanation of the contribution of each chapter, a rationale for the approach and structure taken, and a description of the argument of the thesis. This section will explain how the research aims are achieved, and how each chapter contributes to those aims.

Chapter 1 introduces the research problem, the aims and objectives of this study, and the four key elements of this study, namely coastal management, science, law and the role of local councils. The concept of science application is introduced, explaining why it is important and the challenge it presents to effectively managing coastal issues. The relevance of law to coastal management and its role in the application of science highlight the gap in the existing research on law and science. Finally, the role of local councils in coastal management provides background to why councils are important to understanding the problem of science and the law.

Chapter 2 provides the methods used in this thesis and an overview of the study area. This thesis uses a mixed methods approach consisting of a legal document analysis, interdisciplinary literature review, and qualitative research methods including a period of prolonged engagement with coastal managers and case studies of local councils using semi-structured interviews.

Chapter 3 presents a literature review of previous work that has addressed the problem of science uptake in environmental management and considers the role of law and local councils in coastal management. The literature review is structured in four sections. The first section highlights key ideas about the application of science to management

coming from disciplines concerned with environmental governance. The second section draws upon research on science and policy issues to further consider why science uptake is a problem. This section describes the significance of policy in understanding the role of law in coastal management. The third section examines the role of law in the application of science to environmental management, and highlights that this area has received little attention within the literature. The fourth section reviews legal issues faced by local councils in coastal management. This section supports the thesis' argument that legal requirements for science based management are necessary to ensure coasts are protected, and to provide decision makers with guidance for their decisions.

Chapter 4 presents the results from the legislation analysis, performed to determine how science is made accountable in decision-making through legislation. The results of this analysis contribute to the first aim of this study, to consider how science is applied to coastal management decisions through the law. This chapter discusses the interview data in terms of councils' roles in implementing the law; specifically how they are involved with the science application mechanisms identified in the legislation analysis and the issues or barriers occurring in the law. The discussion of the interview data will contribute to the second aim of this study, to identify how science can be better incorporated into the NSW coastal regulatory framework to achieve improved environmental outcomes.

Chapter 5 discusses local councils' role in managing the risk of coastal hazards and adaptation to climate change, particularly regarding the social challenges councils encounter in their work. This chapter investigates the barriers within science and the law for climate change adaptation through a review of the literature and analysis of interview data. This chapter reviews the role of the courts in interpreting the law through analysis of key coastal case law decisions. The case law review is complementary to the legislation analysis results presented in chapter 4, together providing a view of the two sides of the law – legislation and interpretation through case law. The case law review contributes to the first aim. This chapter identifies how science can be better incorporated in the law in the context of climate change adaptation, contributing to the second aim of this study.

Chapter 6 reviews coastal development issues faced by councils in sustainably managing the coast, highlighting the role of property rights in determining decision outcomes in the coastal zone. Coastal development issues that present barriers to climate change adaptation are discussed, contributing to the second aim of this study.

Chapter 7 argues that councils need a strong legal framework that enables them to manage the risk of coastal hazard and climate change impacts on existing and proposed development. The key legal barriers identified in this thesis for local councils in coastal management are discussed. This chapter recommends potential changes to the legal framework to address these barriers.

Chapter 2: Methods

2.1 Introduction

This thesis uses interdisciplinary research from the fields of legal studies, human geography and coastal management. Legal analysis and human geography research methods are applied to investigate the influence of the law on coastal management at local government level in NSW, and to identify legal issues perceived by Council staff who are involved in coastal decision making.

A mixed methods approach is applied in this thesis, including:

- Document analysis of legislation and case law;
- Prolonged engagement with coastal managers on the south coast of NSW to understand coastal issues, develop research questions and form relationships;
- Case studies of four south coast local councils using semi-structured interviews.

Each method contributes to different aspects of the thesis, either through a role in developing key topics and research aims or in addressing one of the thesis' two research aims (contribution of each method detailed in section 2.3). The use of mixed methods in qualitative research promotes greater reliability of results by consulting multiple and varied sources, termed 'triangulation' (Cope, 2003).

This thesis uses legal analysis to identify science application mechanisms within the law, prolonged engagement to develop understanding of management issues, and case studies with interviews to help explain the law in practice. A case study approach was chosen in order to explain the key management and legal challenges to local councils that were identified through this thesis' legal analysis and period of prolonged engagement with coastal managers. Situations for using a case study are described by Swanborn (2010, pg. 27), who states: "If we want more information about what (groups of) people perceive and decide, in relation to their interaction during a certain period, a case study seems to be the optimal strategy." The results of the legal document analysis, and the information gained by conversing with coastal managers about legal issues at workshops and meetings, led to the question of whether the law is 'working' or 'not working' to protect coastal environments in a management context. This question became a key interest of this thesis. Case studies of local councils were chosen because

local councils are largely responsible for local level coastal management and have a key role in implementing coastal legislation (NSW Government - Department of Climate Change & Energy Efficiency, 2012). The legal challenges in coastal management identified through this thesis' literature review, legal analysis and period of prolonged observation revealed local councils are a key stakeholder impacted by coastal law. The major purpose of case studies in this thesis is to investigate how the law impacts coastal management at the local level, and to identify legal issues that are perceived as a challenge to coastal management.

The south coast of NSW was chosen as the study area in order to investigate particular issues impacting the region. The interview participants include five council staff responsible for the coastal management programs in four south coast local government areas (Table 2.1). Consistent with Baker and Edwards (2012), the relatively small sample of five interviews is considered sufficient to achieve the aim of the interviews. This aim is to gain insight from local council staff involved in coastal management regarding the influence of science and law in their work, and the legal, scientific or other issues perceived to be barriers to protecting coastal environments. The staff directly involved in coastal management at each council were interviewed.

This research received ethics approval from the UOW Human Research Committee (HE11/471). All participants consented to the use of interview material in publication and to be identified by name and role. Participants have been identified by their role and council only, as these are the details relevant to the thesis.

Table 2.1: The five interview participant's roles and NSW local council of employment.

Interviewee 1:	Environmental Strategy Officer	Wollongong City Council
Interviewee 2:	Natural Resources and Floodplain Manager	Shoalhaven City Council
Interviewee 3:	Coasts and Estuaries Officer	Shoalhaven City Council
Interviewee 4:	Coastal and Flood Planner	Eurobodalla Shire Council
Interviewee 5:	Environmental Service Coordinator	Bega Valley Shire Council

2.2 Study Area

The study area includes four local councils on the south coast of NSW: Wollongong City Council, Shoalhaven City Council, Eurobodalla Shire Council, and Bega Valley Shire Council (Figure 2.1). These four council areas are very different in terms of population, which influences the council's financial situation due to rate base constraints, and in terms of development pressure. The thesis conceptualises the four council areas as occurring along a spectrum of population and development characteristics. On one end of the spectrum is a developed urban council with high population density; Wollongong City Council. On the other end of the spectrum is a rural shire with a large geographic area to manage, a low population density, and minimal pressure for development; Bega Valley Shire Council. In the middle of the spectrum are two locations experiencing similar sea change population growth and associated pressure for new development. These points are represented by Shoalhaven City Council, sitting at the more densely populated end of the spectrum, and Eurobodalla Shire Council, sitting at the less densely populated end of the spectrum (Table 2.2). The four councils in the study area account for a large proportion of the land area and population of the south coast region. The south coast councils not included in the study are Shellharbour and Kiama.

Table 2.2: Study area characteristics: The four councils in the study area differ greatly in population, associated development characteristics, and the amount of coastal land managed. These councils occur along a spectrum; at one end is an urban council with high existing development and a strong population base of rate-payers (Wollongong); at the other end is a rural council with a low population base of rate-payers, a large geographic area, and low development pressure (Bega); in between are two councils experiencing population growth and associated pressure for development (Shoalhaven and Eurobodalla). Data sources: (ABS, 2013; WCC, 2015; SCC, 2015; ESC, 2015c; BVSC, 2015).

Local Government Area	Population (2013)	Land area – (hectares/715km ²)	Population density (persons per hectare)	Shoreline length (kilometres)
Wollongong City Council	205,231	71,544	2.87	42 km
Shoalhaven City Council	97,694	453,063	0.22	165 km
Eurobodalla Shire Council	37,234	342,173	0.11	110 km
Bega Valley Shire Council	33,313	627,683	0.05	225 km

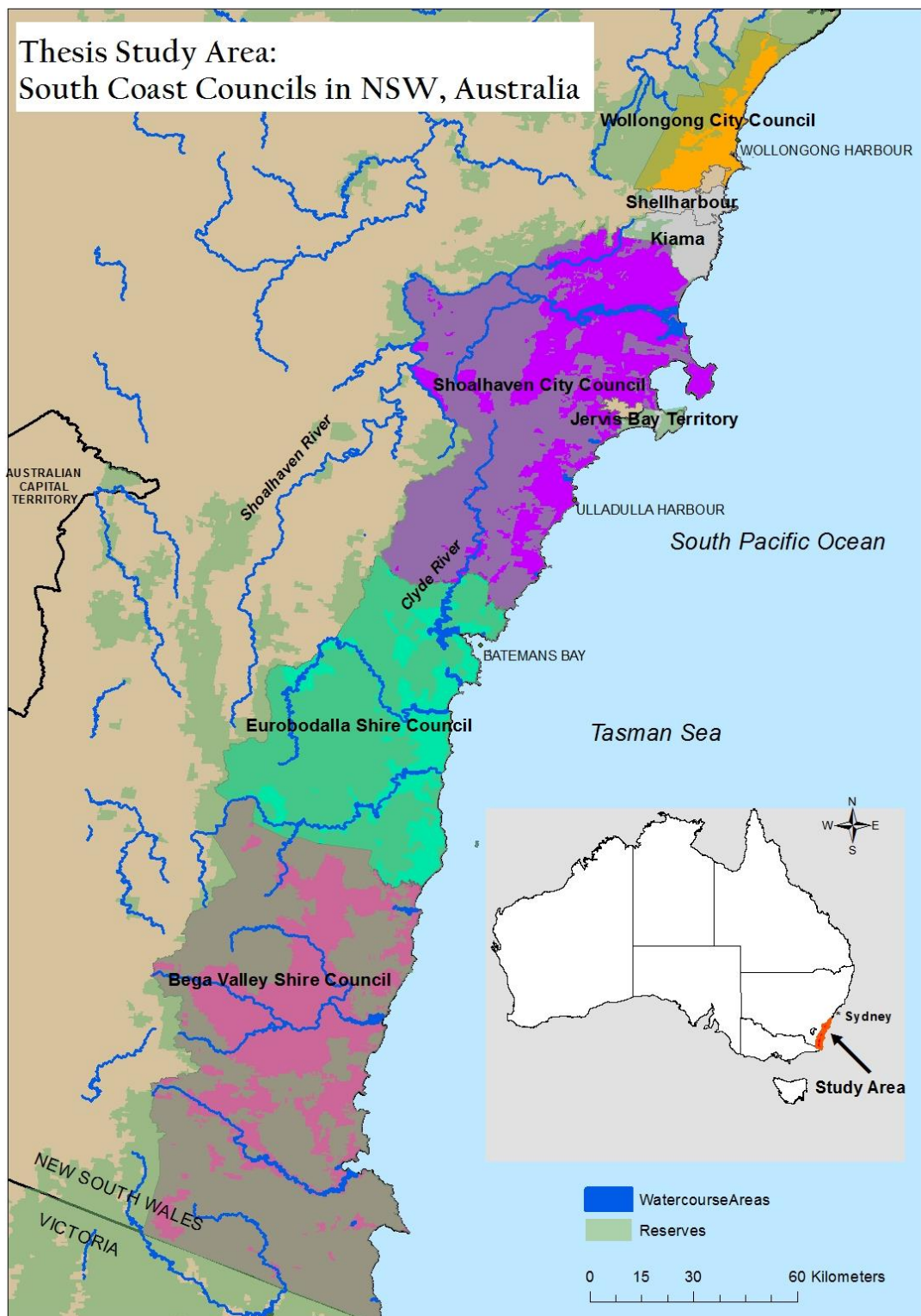


Figure 2.1: Locality map showing the four council areas included in this study: Wollongong City Council, Shoalhaven City Council, Eurobodalla Shire Council, and Bega Valley Shire Council. The map features major watercourses and forest reserves occurring in each council. Data Source: © Commonwealth of Australia (Geoscience Australia) (2006); © Commonwealth of Australia (ABS) (2006).

Coastal features on the south coast of NSW include sandy beaches and rocky shorelines, pocket beaches with sandstone headlands, coastal wetlands, and multiple coastal water bodies. There are two major rivers on the south coast: the Shoalhaven River in Shoalhaven City Council and the Clyde River in Eurobodalla Shire Council. A significant feature on the south coast is its many estuaries, coastal lakes, and lagoons, including multiple Intermittently Closed and Open Lakes and Lagoons (ICOLLs). Estuary management, including ICOLL entrance management, is a key aspect of coastal management on the south coast.

The urban developed council in this study, Wollongong City Council, is the northernmost council area on the south coast of NSW, located in the Illawarra region. It is bordered by the Royal National Park and Sydney's southern suburbs in the north, and by Shellharbour City Council in the south. Wollongong is the third largest city in the state, with an estimated 205,231 people (Wollongong City Council, 2015). Of the four councils in the study, Wollongong has the smallest geographic extent to manage and the highest population and population density. Therefore, in comparison to the other council areas, Wollongong has a higher rate base that could be used to address coastal management issues. With high urban development, Wollongong's coastal management program addresses issues associated with existing development including pressure for development on these properties.

There are two council areas included in the study considered as middle points along a spectrum of development and population: Shoalhaven City Council and Eurobodalla Shire Council. These councils are both experiencing strong population growth and pressure for development. Population density in these regions is much less than what is seen in the study's urban council, Wollongong. Shoalhaven City Council includes 165 kilometres of coastline and has a population of 97,694 people (Shoalhaven City Council, 2014). The major population centre in the Shoalhaven - Bomaderry-Nowra - was one of the fastest growing coastal areas in NSW outside of major cities between 2001-2011, (ABS, 2012). The Eurobodalla coastline is approximately 110 kilometres in length and includes over 40 beaches (ESC, 2015a). Eurobodalla's population is 37,234 people (Eurobodalla Shire Council, 2015c).

The southernmost council in NSW is Bega Valley Shire Council. Bega Valley (often referred to simply as 'Bega') is a rural region and is currently facing less pressure for development than is occurring in the other south coast councils. Bega has the largest geographic area to manage and the smallest population. National parks and state forests are dominant features in Bega; 78% of land in the Shire is included in these areas, leaving just 22% of land rateable. Bega has many coastal features to manage with 225 kilometres of coastline, 101 beaches and 26 estuaries, which is 1/6 of the states' total estuaries. Bega Valley includes several small towns and villages, including the town of Bega, which forms the area's economic and population centre. The council area has an approximate population of 33,313 people (Bega Valley Shire Council, 2015).

2.3 Methodology

A three stage process was adopted in this thesis to explore the question of improving the application of science to coastal management through the law.

Stage One included a document analysis of NSW legislation, policy and case law relevant to coastal management in NSW, and an interdisciplinary literature review. These methods were undertaken to explore the questions of how science is applied to coastal management through the law, and whether there are legal changes that could be made to improve environmental outcomes on the coast. This method was carried out first in order to gain an understanding of critical background information about the legal setting in NSW and legal issues impacting coastal management. The results of this method identify statements in NSW legislation that enable science application to decisions made about the coast, and found whether case law decisions have taken coastal science in to account and the legislation that determined decisions. This method addressed the first aim of the thesis, which is to consider how science is applied to coastal management decisions through the law.

The review of literature addressed issues pertaining to science uptake, the law in coastal management, and the role of local councils. The interdisciplinary literature review investigated disciplines concerned with environmental governance, the role of science in society, the role of science in policy, legal issues in coastal management, climate change adaptation, and local councils. The CSIRO Coastal Collaboration Cluster funded the case law analysis. This method involved a search of court cases in the NSW Land &

Environment Court pertaining to coastal management. The search was performed using the NSW Caselaw website; 28 relevant court cases were identified. Court transcripts of these cases were analysed with the aim of identifying the types of science used as evidence and applied to court decisions.

Stage Two involved an extended period of investigation of coastal management on the south coast of NSW through participation in various professional meetings (Appendix 1). A highlight of this stage included a workshop on 7 May 2012 for coastal managers on the south coast facilitated by the CSIRO Coastal Collaboration Cluster's Integration Theme, of which this researcher was a part. The workshop, entitled 'Barriers to the application of science for climate change', provided a synthesis of the Cluster project including this thesis' legal work, and gained feedback from participants. Later meetings and conferences attended during Stage Two provided the opportunity to speak with participants about the issues identified in the workshop. Engaging with the community of coastal managers provided essential insight for the thesis that could not have been gained from literature alone. This method, termed 'prolonged engagement', is described by Baxter & Eyles (1997, pg. 514):

Prolonged engagement involves spending sufficient time in the field to build trust and rapport with the respondents, to learn the 'culture' of the relevant group(s) and to investigate for possible misinformation/distortions introduced by self or respondents.

By engaging with groups of coastal managers, a first-hand perspective of the issues impacting the work of coastal managers and an understanding of the roles different authorities have in managing the coasts was gained. The major contribution of this stage was in developing the key topics and research aims of the thesis, identifying potential interview participants, and developing interview questions. Detailed observation notes were taken at all meetings and later analysed to identify themes. Attendance at these events contributed to developing and clarifying understanding of key issues within coastal management pertaining to law and science.

Stage Three involved semi-structured interviews with five participants from four local councils on the South Coast of NSW, Australia (Table 2.1) who are directly involved in coastal management. As argued by several authors in the multi-author review 'How

many qualitative interviews is enough?’ (Baker and Edwards, 2012), only a few interviews, or even just one, is adequate depending on the purpose of the research project. The purpose of the interviews in this project was to gain insight from local council staff involved in coastal management regarding their experiences of the influence of science and law in their work, and the legal, scientific or other issues perceived to be barriers to protecting coastal environments. This stage addressed the second aim of this thesis, which is to identify how science can be better incorporated into the NSW coastal regulatory framework to achieve improved environmental outcomes.

To recruit participants, contact was made with the council staff responsible for estuary and coastal management at each of the six south coast councils. Contact details had been obtained during Stage Two of the thesis, through which the researcher in this thesis had become acquainted with these council staff. Five representatives from four councils accepted the interview request. Interviews were conducted at the council buildings in Wollongong, Shellharbour, and Eurobodalla, and at Tathra Surf Life Saving Club in Bega. The first interview was with the Environmental Strategy Officer at Wollongong City Council on September 24, 2013. The second interview took place at Shoalhaven City Council on October 17, 2013 and was with two staff members, the Coasts and Estuaries Officer and the Natural Resources and Floodplain Manager. The final two interviews took place on November 29, 2013. The first interview this day was with the Environmental Service Coordinator at Bega Valley Shire Council. The second was with the Coastal and Flood Planner at Eurobodalla Shire Council.

The method used for interviewing was a semi-structured technique, an approach that is “organised around ordered but flexible questioning,” (Dunn, 2005). The same list of prepared questions was used for each interview (Appendix 2). All questions were addressed in the interviews, however discussion was not restricted to these questions. The benefit of using a semi-structured technique for interviews is described by Longhurst (2003, pg. 121): “Allowing the discussion to unfold in a conversational manner offers participants the chance to explore issues they feel are important.”

The interview questions focused on the work of the councils and were structured within four topics: coastal management, science, the law, and connections between law and science. The coastal management topic asked questions to ascertain what the

interviewees considered to be the key coastal management issues in their council area, the major social or human influences on coastal decisions, and whether they felt there were any barriers impeding management of the issues. Questions within the science topic focused on the role and influence science had in their work and the major sources of their scientific information. Within the law topic, questions were asked to evaluate the extent to which the law influenced the daily work of councils, and whether any issues within the law were seen as obstacles to coastal management. The final topic on law and science focused on particular examples within their work where there had been a discrepancy between the law and science, how this was handled and whether there were any feedback loops enabling councils' experiences to inform state policy and law. Audio recordings of the interviews were made and later transcribed.

The interview transcripts were analysed using coding to identify key issues pertaining to legal and scientific issues in councils' management of the coast. "Coding should be seen as an active, thoughtful process that generates themes and elicits meanings, thereby enabling the researcher to produce representations of the data that are lively, valid and suggestive of some broader connections to the scholarly literature" (Cope, 2003). The transcripts were analysed to identify themes that were common across the interviews, and variances in the themes across the four LGAs. Some themes were expected due to the nature of the interview questions and findings from Stage One and Two methods. These included themes related to coastal planning for climate change, sea level rise benchmarks and council concern regarding liability for coastal decision-making. Unexpected themes also emerged during the coding process providing new elements to the research. The interview data was interpreted and compared to determine similarities and variances in the issues experienced across the four LGAs.

Chapter 3: Literature Review

Despite the importance of scientific research to environmental management, the literature points out that the application of science to decision-making, or science uptake, is often poor (Bultitude et al., 2012; Cash et al., 2002; Cash et al., 2006; Vogel et al., 2007). The application of science to environmental management has been researched extensively in recent years, particularly across disciplines concerned with environmental governance, the role of science in society, and the role of science in policy. Key points from this literature are reviewed in 3.1 and 3.2. The literature directly addresses issues regarding connections between science, policy and decision-making, however there is relatively little discussion regarding legal mechanisms for applying science to environmental management. Despite this gap in the literature, research from disciplines related to the law, local councils and climate change impacts on the coast provides insights for understanding the role of law in coastal management and legal connections to science uptake. This literature is reviewed in 3.3 and 3.4.

3.1 Science Uptake within Complex Governance Networks

A major focus within the science uptake literature is on issues associated with engagement and communication between stakeholder groups within environmental governance systems. A key understanding in this body of research is that the interactions between stakeholders within multi-governance systems influence whether science is applied to coastal decisions. It is widely argued that issues related to engagement, communication and stakeholder relationships act as barriers to incorporating science into decision-making (Bultitude et al., 2012; Cash et al., 2003; Cash et al., 2006; Clarke et al., 2013; Pahl-Wostl and Hare, 2004). The problem, put simply by Vogel et al. (2007, pg.353), is that “science has little chance to enter into decision-making or inform action at all when communication is poor or non-existent.” The research criticises traditional linear concepts of science transfer to policy and decision-making where it is assumed that science, often created with little or no input from other stakeholders, will simply be taken up by managers, policy-makers and the community (Jasanoff, 2003; Nowotny et al., 2003; Vogel et al., 2007).

Part of the challenge to science uptake in environmental management is effective engagement across stakeholder groups to integrate the diverse knowledge types from these groups into decision-making (Coffey and O'Toole, 2012; Innes and Booher, 2004; Lazarow et al., 2006; Harvey et al., 2012). Many people are involved in coastal governance coming from various government authorities, communities, NGOs, industry and science. Each of these groups has specific roles, interests and powers in governing the coast and provides various types of knowledge relevant to managing environmental and related socio-economic issues. The major power for managing the coast of Australia rests with the states and territories; under the Australian constitution, states have jurisdiction over their coast and marine waters to three nautical miles. Local government areas (LGAs) within each state are given particular coastal management responsibilities through state law and policy. Responsibilities in coastal management are also split across resources, with various state government agencies involved in managing particular resources such as fisheries, water, national parks or particular activities such as planning and development.

With multiple groups involved in managing particular aspects of coastal, marine and terrestrial environments in the coastal zone, it is clear why collaboration and integration is needed. For example, the coast is split in various ways influencing jurisdictional powers of institutions to manage a part of the coast; however environmental processes and issues occur across institutional jurisdictions. To manage issues at environmental scales it is therefore necessary for collaboration and cooperation to occur across institutions; this is one aspect of integrated coastal zone management (Cicin-Sain and Knecht, 1998). Furthermore, governance of environmental resources involves people from the community and private industries who are connected to and dependent on coastal resources. A key argument within the literature is that in order to effectively manage environmental problems it is essential that governance systems integrate the various knowledge types with respect to the relevance and reliability of each (Selman, 2000; Weichselgartner and Kasperson, 2010). Much of the literature related to science uptake considers approaches to improve processes of engagement across stakeholder groups. The research points to the need for collaborative processes in which the various players come together equally to share knowledge and address coastal management issues (Leith and Haward, 2010; Clarke et al., 2013). It is argued that through such processes a valuable shift away from the traditional mode of one-way science transfer

(to managers, policy, and community) can occur. Instead we will have situations in which the science produced is more readily applied because it has been influenced by the social and cultural context of a location (Vogel et al., 2007). Through effective engagement, understandings of the socio-cultural, management and governance contexts are gained, allowing problem solving approaches to be developed that fit within the local context (Nowotny et al., 2001; Vogel et al., 2007).

The literature provides insight into specific barriers to science uptake occurring in the absence of effective stakeholder engagement. For example, poor communication between scientists, coastal managers and policy-makers prior to undertaking research may result in the production of science that does not meet management and policy needs. Furthermore, when science is not effectively communicated to managers and policy-makers, scientific findings are lost to the practice community. In his paper on improving the application of science through policy, Watson (2005) discusses these engagement and communication barriers occurring in a global scale environmental assessment of biodiversity. The subsequent result was that the science, though providing significant data, had little impact on policy outcomes. To avoid such circumstances, some scholars have recommended that scientists should engage with other stakeholders from the outset of research programs and ongoing; these experiences help shape research agendas so the science produced is useful and usable (Watson, 2005; Vogel et al., 2007).

The research also highlights barriers to science uptake resulting from poor engagement with the public. Engaging the community in coastal management processes is important for overcoming lack of policy acceptance by the public and subsequent failure to implement appropriate management strategies, a key barrier to science uptake (Stocker et al., 2012). When scientists do not make use of local knowledge and expertise about the environment, its history and local management strategies, the science produced loses credibility in the opinion of the public. Without credibility, the science is not accepted by the community which in turn limits science uptake (Wynne, 1996). It is argued in the science uptake literature that when communities are engaged, science production will be framed within the context of the socio-cultural setting and provides opportunities to incorporate useful local knowledge about the environment. Through

these processes of engagement, science gains legitimacy and is more likely to be accepted by the community (Wynne, 1996; Vogel et al., 2007; Leith et al., 2012).

3.2 The Role of Science in Environmental Policy

There is a significant body of research that considers the links between science and policy and provides insight into the issue of science uptake. This literature is also relevant to understanding the role of law in environmental management, as policy and law are closely linked in their roles. Legislation and regulations are the only true legal instruments; however the line between policy and law is not always clear cut. For example, a policy can be deemed a statutory instrument by legislation or by official directions issued by a State Minister (Ministerial Directions) who has been given legal power to do so. This entanglement between policy and law implies that a legal understanding of the application of science will at times cross over into the realm of public policy. This section highlights key points from the science policy literature relevant to improving the application of science to environmental management through policy, in light of the link between policy and law.

Debates on science and policy are inextricably linked to questions about the role of science in society. Scientific research has always been an important contributor to environmental policy through the provision of knowledge about environmental processes and response (Godden and Peel, 2010). However, in more recent times science is called upon to help address issues within society. For example, projections of climate change impacts on coastal environments, resources and communities are provided by science, most prominently through the work of the Intergovernmental Panel on Climate Change (IPCC). The differing characteristics of science and policy mean that their relationship is not always an easy one. Policy requires information that will directly inform decision responses and that will hold up under political and public scrutiny. Science on the other hand embraces uncertainty, understood in the scientific community as an inherent characteristic of science. Weinberg (1977) argues that policy often asks questions of science that science cannot answer. These questions, described as 'trans-scientific', require science to provide predictions it cannot make (Weinberg, 1977).

Despite the inconsistency between policy needs and science capabilities, science is essential to public policy. Within society it is expected that regulatory decisions of governments have a scientific rationale in order to gain legitimacy (Jasanoff, 1987). There is a general acceptance that public policy is to be based on evidence, both scientific and other, described in recent years as 'evidence based policy' (Holmes and Clark, 2008; Marston and Watts, 2003; Bogenschneider and Corbett, 2010). Furthermore, connecting science to policy is particularly pertinent for managing human uses of natural resources and environmental problems. There are various examples at local, national and international levels in which science, particularly assessments of change in the environment and potential futures scenarios, has led to policy responses to manage an environmental problem (Watson, 2005). The goal of improving the connections between science and policy has been taken up by several key groups and research programs in Australia. The Wentworth Group of Concerned Scientists was established by a prominent group of Australian scientists in order to promote the use of science by federal and state governments in public policy. The research organisation, the National Climate Change Adaptation Research Facility (NCCARF), has supported decision makers and policy development by providing science on issues related to climate change and managing the pressures on coastal communities.

Funtowicz and Ravetz (1993) argue that the role of science in society has changed in recent decades because policy issues of environment and risk (which require science) are issues where, "facts are uncertain, values in dispute, stakes high and decisions urgent," (Funtowicz and Ravetz, 1993, p.744). These authors describe the emergence of a new type of science, termed 'post-normal science', in response to environment and risk issues. Post-normal science is characterised by the involvement of multiple groups and individuals having a stake in the resolution of these issues. Resolving post-normal science policy issues, including processes of science production and application to management, involves multiple stakeholders who participate in framing the problem as well as determining the legitimacy of scientific inputs (Funtowicz and Ravetz, 1993). This factor is influential on local councils' management of the coast because consulting with the local community is an integral part of their coastal management processes. Local councils have been challenged by community opposition to development restrictions, or other implications for private property resulting from councils' work in undertaking coastal hazard assessments.

Interactions between stakeholders involved in science and policy has been analysed through the concept of 'science policy interfaces.' One definition envisions science policy interfaces as "social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making," (van den Hove, 2007, pg. 815). It is argued by van den Hove (2007) that the characteristic problems often arising when science is called upon by policy can be addressed by facilitating processes of engagement and communication between scientists and other actors. The co-production of knowledge across scientific disciplines, policy and the practice community is argued to be essential to address the challenge of integrating socioeconomic with biophysical factors in research, particularly regarding complex issues such as climate change vulnerability and resilience in communities (Weichselgartner and Kasperson, 2010). A particular challenge for local councils is incorporating social sciences within their coastal management actions. Council officers interviewed in this study felt that there is a lack of tools for effectively assessing coastal values from the community as a whole, a point discussed further in chapter 5.4 and 7.2.

3.3 Science Uptake and the Law

The connections between science and policy have been researched extensively, however the role of law in relation to science uptake has received little attention within the scientific literature. This may be attributed to the relative roles of policy and law in environmental management combined with the ever-changing nature of science.

To illustrate this point, first consider the relevance of law and policy in environmental management. Law has the major purpose of delegating responsibility to decision makers, providing an enforceable means to implement public policy (Bates, 2013). In this way, legislation acts as a 'policy instrument', often created in response to the process of policy-making (Olsen et al., 1997). Policies, which are generally created prior to legislation, are developed based on evidence about the problem being addressed, including scientific evidence. In this way science informs policy development and policy incorporates scientific knowledge about the environment. The science-policy relationship and related barriers are considered in the science policy literature. Policies will also provide specific details of how governments' goals and objectives for coastal planning and management are going to be achieved. Within this level of detail

management requirements based on science are found. For example, the NSW Coastal Policy sets out strategic actions to be undertaken in order to achieve coastal management objectives. Many of these strategic actions require science, such as monitoring biodiversity, habitat, and water quality, creating management plans, and researching land and soil rehabilitation (NSW Government, 1997). The role of the law, through legislation, regulations and Ministerial Directions, is to delegate responsibility to coastal managers to adhere to the NSW Coastal Policy, undertaking its role as a policy instrument. Hence, the important role of science in environmental policy creation - and the difficult relationship between science and policy - has led to a body of literature that has considered the connections and barriers in science and policy (Jasanoff, 1987; Oreskes, 2004; Sarewitz, 2004; Juntti et al., 2009).

Another explanation for the emphasis of science within policy as opposed to legislation may be that policy is better suited to incorporate new science than is the law. This argument relates to the point that policy is more easily changed than law. To change legislation often involves processes of inquiry, including expert consultation and public submissions and must then go through parliamentary processes to approve amendments (Parliament of New South Wales, 2015). Changing policy, on the other hand, does not involve this stringent process.

An argument of this thesis is that to ensure coastal decisions made by regulated authorities are based upon scientific understandings, it is important that the law enables the best science to be applied to decisions. The role of policy in environmental management and its compatibility with the ever-changing nature of science may explain why policy is significant to science uptake. On the other hand, because policy is more easily changed than law it provides little security to the decision makers acting under the legal and policy framework and to ensuring coastal management is aligned with scientific principles.

3.4 Local Councils and the Law

The experiences of local councils are important to understanding the role of law in coastal management, particularly with regard to the legal issues faced by councils in relation to coastal hazards. The literature on environmental law, climate change and local councils points to a need for a sound legal and policy framework to support local

councils in their role in adapting to climate change impacts on the coast. The work of IPCC has made it clear that coasts are currently experiencing increased coastal inundation and erosion due the effects of climate change, including sea level rise and changes to storm characteristics (IPCC, 2013). Furthermore, coasts are certain to face increasing risks for many decades to come; thus the need for planning with consideration of future conditions is imperative in order to mitigate damage to coastal ecosystems and human settlements (IPCC, 2013).

There is a need in Australia to reconsider the way in which development is approved on the coast in order to adapt to future climate change conditions; this point was made by the recent parliamentary inquiry into climate change and environmental impacts on coastal communities (HoR, 2009). The planning laws in NSW, however, have been criticised for not achieving their full potential when it comes to climate change adaptation (EDO, 2010; Ghanem and Ruddock, 2011).

Without a clear legal framework to enable planning for climate change impacts, the law acts as a barrier to climate change adaptation. In their framework to diagnose barriers to climate change adaptation occurring within a governance system, Ekstrom et al. (2010) discuss the influence of law on a system's ability to adapt to climate change. In looking at the role the legal framework has in adaptation, it should be asked "What are the laws that govern certain options and do they favour or inhibit the selection of certain options?" (Ekstrom et al., 2010, pg. 39). Ekstrom et al. (2010) argue that for decision makers to make the changes needed to adapt to climate change, the system of governance for a coastal area, including its laws, must enable these changes to be made. The law is relevant to the actions taken by local councils as their responsibilities are undertaken within the framework of applicable legislation, regulations and policies. Essentially the law guides and determines their work; it sets out what councils can and cannot do. Therefore, even if councils want to base their decisions on the best available science, if the law has not been updated then there is no legal basis for their decision. This is particularly relevant in the case of local councils' role in determining development outcomes through assessment of development applications. Council decisions must be aligned and updated in accordance with requirements from the law, policy and Ministerial directions. This is particularly important for councils to reduce financial and liability risks as development applications can be and often are appealed if they are

refused by the council. It is an option for councils to refuse an appealed application and be taken to court. A court will determine the lawfulness of the councils' decision by assessing whether the decision is aligned with legislation, policy and guidelines such as Ministerial directions. A decision based on the best science can be overturned by a court if the decision is found to be inconsistent with the law. Furthermore, involvement in legal action for appealed applications is a costly exercise for councils, creating additional costs to already limited funding. It is argued that the law should act to "provide certainty to those managing the uncertain," (EDO, 2010, pg.4).

Despite the lack of clear requirements in the law for addressing climate change risks, local councils have a legal responsibility to base their development and land use planning decisions on the science of climate change. McDonald (2007) points out that future court cases will consider whether decisions were based on current acceptable scientific knowledge in order to reduce or avoid climate change risks. A major concern of local councils, and a key issue discussed within the legal literature on coastal management, is potential liability councils may face for damage to private property due to inappropriate planning or action on their part (Ghanem et al., 2008; Forbes, 2009; Lipman and Stokes, 2011). Several court cases have already been to the NSW Land and Environment Court involving private property owners and local councils with regard to coastal erosion and property damage (*Byron Shire Council v Vaughan, Vaughan v Byron Shire Council* (2009) NSWLEC 88, *Warringah Council V Franks & Ors* (1999) NSWLEC 65). In a report commissioned by the Australian Local Government Association to review potential climate change liability, the authors expressed the view that councils would likely face increased climate change related litigation, creating a financial burden for local government (Baker & McKenzie, 2011). In her analysis of liability risk of public authorities for their decisions with respect to climate change risks, McDonald (2007) discusses three key areas of council decision-making that are likely to be contested in the future. These include the development controls and standards councils adopt; their decisions on development applications, including the use of conditions to address coastal flooding and erosion; and the approaches taken to coastal protection. She argues that it is imperative to include adaptive measures through land use planning and development design in order to reduce vulnerability of human settlements and the risk of liability for councils' decisions. To reduce litigation local governments require a supportive decision-making framework in which scientific information regarding climate

change risks can be incorporated as a component of their criteria for coastal land use (McDonald, 2007).

To support local councils' work to implement climate change policy, councils need a supportive legal framework giving them a clear statutory basis for addressing climate change risks to the coast. Addressing climate change adaptation, including issues surrounding implementation of changes occurring within the NSW legislative and policy framework has been a major challenge for local councils (EDO, 2010; Scarlett and Gangaiya, 2012). Coastal adaptation policy, which involves approaches to control or restrict development, is characterised by the involvement of multiple groups and individuals having a stake in the resolution of these issues, in line with Funtowicz & Ravetz's (1993) definition of a 'post-normal science' issue. Councils are responsible for planning for sea level rise impacts on their communities; however sea level rise management strategies are controversial in the public domain as the approaches taken can have significant impacts for the environment, communities and individual property owners.

3.5 Conclusion

The literature review provides insight into science uptake and the role of local councils in managing coastal issues. A key idea within the science uptake literature is that governance issues, particularly difficulties associated with engagement across stakeholder groups, result in barriers to the application of science to environmental management. Improving the uptake of science by coastal managers and policy-makers has been researched extensively within the fields of environmental governance and environmental policy. The review of the governance and policy literature found that better engagement between the many groups involved in coastal management, including coastal managers, policy-makers, the community and scientists, is needed to improve the application of science to coastal management. Improving connections within governance networks is crucial in order to create science that is relevant and available to coastal managers and policy-makers, and to enhance community acceptance of coastal policy and management strategies. These research findings from the literature have influenced the approach taken in this study to investigate the role of law in science uptake. The role of law in councils' decision making, and the legal issues associated with coastal management and the use of science are evaluated in this thesis

through an investigation of challenges in councils' work, including social and governance factors.

Legal issues related to local councils and coastal management are pertinent issues raised within the literature on environmental law, climate change and local councils. This research informs us that the law and science are each important components for councils to manage the risk of coastal hazards and climate change impacts on coastal communities. The role of the law in the application of science, however, has received relatively little attention. The law determines the options councils may take to manage the coastal zone, and science provides knowledge about the physical and social characteristics of a location. The application of science to managing coastal hazards, and having a legal framework that enables hazard management decisions to apply the best science, are critical to the work of coastal councils. Science and the law are needed to enable councils to make decisions that promote adaptation to future climate change impacts, and to protect local councils from financial risk of liability for their decisions. A key issue in legal literature related to local councils in coastal management is the concern of councils' risk of liability. If a council allows a development that is exposed to coastal hazards in the future due to climate change impacts, that council may be liable for damages to the property. The literature says there is a need for a clear legal framework that enables science to be applied to decisions in order to adapt to coastal climate change and reduce the risk of liability. This thesis aims to address the gap in the literature on the role of law in science uptake.

Chapter 4: The Law in Coastal Management

Legislation pertaining to the coastal zone is a key factor in determining how a state's coastlines are managed. This chapter investigates how science is applied to coastal management through NSW legislation. Insights will be drawn from an analysis of coastal legislation and the research interviews to provide an account of the ways in which the law facilitates and limits the application of science in coastal management. This chapter describes the NSW coastal legal framework, including an explanation of the use of the law by State government to respond to coastal management issues. This is pertinent in developing an understanding of the role of the law in implementation of State policy, which in turn determines councils' requirements for managing their coastline. The chapter highlights the changing nature of the law and the impact of change for councils, at times creating barriers to effective management of the coast.

4.1 NSW Coastal Legislation

The use of legislation to manage the coast in NSW largely evolved in response to coastal environmental issues (Harvey et al., 2012), highlighting the relationship between the legislation created and the environmental and socio-economic issues experienced in society. Coastal erosion became a serious issue of concern in NSW from the late 1960's to late 1970's, when severe erosion occurred at various locations, most notably from the extreme weather events of 1974 and 1978 (Short, 2008; Gordon et al., 2011). These events resulted in damage and destruction to property and infrastructure, including the loss of three houses at Wamberal Beach in Gosford, NSW following the 1978 storms (Short, 2008). During this time, there were many cases in which private property owners or local councils responded in these emergency situations by installing protective structures on the beach, often resulting in inappropriate structures and materials placed on the coast (Thom, 2003). At this time there were no coordinated approaches to manage coasts and hazard events, and there was a lack of understanding about the impacts that un-planned 'ad-hoc' protection could have on coastal environments. This approach often worsens the problem by re-directing the erosive impacts onto the property or to another location on the coastline (Woodroffe, 2002), thus transferring the impacts and the costs to other communities or users.

To better understand and manage the issues of coastal erosion, ad-hoc protection works, and the principal problem of inappropriate placement of development on the coast, the NSW State Government responded by initiating various policies, coastal improvement programs and changes to the legal framework for the coast from the late 1970's. The State's first specific coastal legislation, the *Coastal Protection Act* was created in 1979; at the time, this was a progressive step in coastal management. This legislation aimed to improve the relationship between development and the coast, setting out that development and use of the coastal zone must not adversely affect any beach or ocean processes ('the behaviour of the sea') or be affected by these processes (*CP Act 1979*). The *Coastal Protection Act* provides a basis for councils to manage their coastlines through strategic planning, encouraging councils to develop Coastal Zone Management Plans. Furthermore, provisions for protecting coastal values were incorporated into the State's key planning legislation, the *Environmental Planning and Assessment Act 1979*. The legal requirements for managing the coast are supported by documents to provide guidance on appropriate approaches and management responses, including the 1988 Coastline Hazard Policy, the 1990 Coastline Management Manual, the 1997 Coastal Policy, and the Coastal Protection SEPP 71 in 2002. These legal and policy initiatives provided councils with a framework to guide management decisions and a legal basis for protecting coastal environments by limiting unsustainable actions.

The legislation analysis in this chapter focuses on the two principal Acts influencing coastal management in NSW, the *Coastal Protection Act 1979* and the *Environmental Planning & Assessment Act 1979*. Although these two Acts are the major focus of this thesis, it is recognised that there are many pieces of legislation that councils consider when managing the coast, as outlined in Table 4.1. Each of these Acts and Regulations addresses specific aspects of the environment, such as water quality, coastal habitats, or threatened species; or apply to particular areas that may occur within a local government area, such as national parks, Crown land or marine parks. The importance of the legislation and policy framework in the work of councils was commented on by the Environmental Strategy Officer at Wollongong City Council:

Councils are really guided by what they are legally obliged to do, so we look at all the legislation and do things in accordance. For example, any planning

considerations to follow in the provisions of the Environmental Planning & Assessment Act; anything that's in an estuary or foreshore area, we have to look at all the legislation that applies – Fisheries Management Act, Threatened Species Act, etcetera; if it's cultural - National Parks and Wildlife Act. In all of the things we do, we are guided by the legislation that applies and the policy framework (Wollongong City Council 24 September 2013).

Table 4.1: NSW legislation relating to coastal management and how it influences the work of local government.

NSW Legislation	Year	Influence on the Work of Local Government
<i>National Parks and Wildlife Act</i>	1974	Provides for conservation of nature and culture in NSW. Local councils consider the Act in relation to all national parks, historic sites, nature reserves, Aboriginal areas and state conservation areas that exist within the council.
<i>Coastal Protection Act</i>	1979	Provides for the protection of the coast for current and future generations. Local councils apply the Act to all land use planning and development assessment decisions made in the coastal zone. The Act provides requirements for a council's Coastal Zone Management Plan (CZMP).
<i>Environmental Planning and Assessment Act</i>	1979	Enables state-wide strategic planning through Environmental Planning Instruments. The Act regulates development assessment processes undertaken by local councils and other consent authorities.
<i>Crown Lands Act</i>	1989	Ensures fair management of Crown Land for the benefit of the people of NSW. Local councils must consider the Act in relation to council managed Crown Land. The Minister can impose restrictions if Crown Land is sold in order to protect environmental and cultural values held by the land; councils implement restrictions when assessing development.
<i>Local Government Act</i>	1993	Provides the legal framework for local government. The Act regulates relationships within the system of local government, encourages local community participation, sets out councils' responsibilities, and requires local government to have regard to the principles of ESD.
<i>Fisheries Management Act</i>	1994	Manages fish and their habitats including mangroves, seagrasses and other marine vegetation. The Act provides for Fish Habitat Protection Plans; when gazetted, local councils must take into account the protection strategies within the plan to ensure that those habitats are protected. If development may harm fish habitats or involves aquaculture, the consent authority (e.g. council) must forward the application to the Department of Primary Industries to obtain approval permits.

<i>Threatened Species Conservation Act</i>	1995	Provides for the identification and conservation of threatened species, populations and ecological communities. Councils have a key role in achieving state conservation goals through their role in strategic land use planning for biodiversity protection. The Act has implications for councils' development assessment, particularly regarding threatened species impact assessment and compliance.
<i>Protection of the Environment Operations Act</i>	1997	Provides for the protection, restoration and enhancement of the quality of the NSW environment through regulation of factors such as pollution and water quality. Local councils, in addition to the EPA, are given responsibilities under the Act as a regulatory authority.
<i>Environmental Planning and Assessment Regulation</i>	2000	Provides requirements for councils' Development Control Plans (DCPs), regulates existing uses, and sets out procedures relating to development applications.
<i>Water Management Act</i>	2000	Provides for the sustainable and integrated management of the state's water for the benefit of both present and future generations. Water management plans related to rivers, groundwater, floodplains and estuaries can be made under the Act. When exercising its functions, a local council must have regard to the provisions of any management plan.
<i>Native Vegetation Act</i>	2003	Regulates the removal or killing of native vegetation on most land in NSW. The Act has implications for councils' role in development assessment, particularly where a development requires dual consent including Local Land Services (LLS) to approve the landowners plan for vegetation management. The Act also impacts councils' role as land managers (see Native Vegetation Regulation below).
<i>Coastal Protection Regulation</i>	2011	Provides requirements pertaining to the use of coastal protection works, including temporary works. Under the Regulation, any development below the high water mark must be submitted to the NSW Minister for approval; this however does not apply when a council has an approved Coastal Zone Management Plan.
<i>Native Vegetation Regulation</i>	2013	Provides authority to local councils to carry out routine agricultural management activities that apply to Crown land under their management, including roads, tracks, viewing platforms, signs and recreational facilities (such as picnic and barbecue facilities).
<i>Marine Estate Management Act</i>	2014	Provides for strategic and integrated management of NSW marine waters, coasts and estuaries. The Act enables state government to create marine parks and aquatic reserves. Marine estate management plans may have implications for land use planning undertaken by local councils.

The *Coastal Protection Act* provides a framework for the management and protection of the State's coastal zone. The major purpose of the Act is to:

- Define the geographical boundaries of the coastal zone.
- Delegate power to carry out the Act, generally including the Minister for the Environment, local councils, and the NSW Coastal Panel, which is established by the Act.
- Provide principles for the use of the coastal zone.
- Explain instances in which development applications are to receive approval by the Minister.
- Provide requirements for local councils' coastal zone management plans (CZMPs).
- Establish requirements for coastal protection works.

The major purpose of the *Environmental Planning & Assessment Act 1979* is to provide a framework for a co-ordinated approach to land use and development in the State. The objects of the Act promote social and economic welfare of communities by providing affordable housing, services, land for public use, and promote environmental protection and conservation. The major role of the Act is to:

- Delegate power to The Minister, Director-General, The Department, and establish various planning and assessment committees.
- Provide for the use of environmental planning instruments to promote co-ordinated planning, including State Environmental Planning Policies by the Minister and the development of Local Environment Plans by local councils, and development control plans.
- Provide a framework for development assessment.
- Set requirements for assessment of a proposed developments' impact on the environment.

In analysing the role of law, an important and often complicated aspect to consider is the relationship between law and policy and their respective roles in applying science to

coastal management. The line between law and policy is not always clear cut. Acts and Regulations are the only instruments with true legal standing, however there are mechanisms within the law to require the use of Policy and Guidelines, such as Ministerial Directions or reference within the legislation to a Policy. Furthermore, it is often policy that contains more specific requirements for science than the law. The implication of these points for this research is that it has been necessary to look at both policy and legislation in order to understand the framework that determines how science is applied through the law.

4.2 Legislation Reform and Councils Managing the Coast

The current coastal legal setting in New South Wales is one of reform. In 2012, the State government commenced a two-stage reform process to assess the *NSW Coastal Protection Act 1979*. Multiple changes were made during Stage 1 in 2013 and 2014, including removal of state-wide sea level rise planning benchmarks, new provisions for coastal protection works, and changes to councils' use of hazard notations on planning certificates. The Stage 1 reforms were a key issue discussed at the NSW Coastal Conferences in 2012 and 2013. In particular, the 2012 conference was held within several months of the Minister's announcement that the state-wide sea level rise planning benchmarks were no longer required for councils to use. The impact of this and other legal changes were a key concern for coastal councils during the conference and since this time. The issues associated with these changes have been captured by this thesis' interviews with the south coast councils; these interviews were conducted towards the end of 2013, approximately one year after the removal of the NSW sea level rise planning benchmarks. The impact of this change on the work undertaken by councils to address the risks of coastal hazards and climate change was an overarching theme coming from the interviews. The reform process is now in the second stage, with the Minister announcing Stage 2 commencement at the NSW Coastal Conference in 2014. He also delivered an overview of the key components of the reform, in particular the plan to replace the current *Coastal Protection Act 1979* with new legislation.

A brief summary of the impact of the two-stage coastal reforms on local councils is given below. It is, however, beyond the scope of this thesis to provide a comprehensive analysis of the changes occurring to all legislation; the legislation analysis results presented in this thesis address the current Acts. Despite the recent changes that have

occurred to the legislation, research into the legislative framework prior to these changes is relevant for several reasons. First, the interviews conducted with local councils have focused on participants' experiences in managing the coast, and thus far their experiences have been under the current framework. The point that legislation is a key factor in determining how coastlines are managed was highlighted in the interviews. Council staff explained that local council coastal management programs and the actions taken within their programs are determined by the relevant legislation. Second, with regard to councils' concern for liability, future court cases will consider the legal framework in place at the time of the decision. Thus, understanding how science is applied in the legal framework prior to recent changes provides reference for future decisions.

The key driver of the coastal reforms has been the risk of coastal hazards and climate change impacts on coastal development. The major issues addressed through these reforms have been council requirements to plan for sea level rise, and improve arrangements for coastal protection works, with a particular emphasis on clarifying landowners' rights and restrictions in undertaking emergency protection works. Of particular relevance to this research are the changes regarding council planning for sea level rise, which have had major implications for the work of councils and have been indicated in the research interviews to be a challenging aspect over the past several years.

In 2009 the NSW Government released their first Sea Level Rise Policy "to provide guidance supporting consistent considerations of sea level rise impacts, within applicable decision-making frameworks" (NSW Government, 2009, pg. 3). The policy contained sea level rise planning benchmarks for council use in hazard assessments. Several councils in this study implemented the new policy by using the benchmarks in their hazard studies for development of draft Coastal Zone Management Plans (CZMPs). These councils were at varying stages in developing their draft CZMPs when in 2012 the State government announced, as part of the coastal reforms package, that the Sea Level Rise Policy Statement was no longer a NSW Policy, therefore the sea level rise planning benchmarks are no longer applicable. Councils were advised they were responsible for determining their own planning benchmarks.

The line of legislation reforms for NSW coastal management, and the impact for local councils in particular, created a sense of frustration, which was widely expressed at the NSW Coastal Conference 2012, held in Kiama in November, just two months after the Ministerial announcement of the reforms. A part of the sense of frustration with the reforms regards the changed requirements for coastal zone management plans and related coastal hazard assessments, in 2009, 2011 and 2012, which has hindered the progress of some local councils in finalizing their plans (Scarlett and Gangaiya, 2012). Several south coast councils have been involved in long term processes to create a coastal zone management plan and have it accepted by the community and council. Each new regulatory change requires councils to re-think the situation, update their studies and plans, while having the responsibility of making decisions consistent with contemporary legislation and policy and delivering information to the community. The barrier created by the reforms on councils' actions to develop and implement their coastal zone management plans is apparent in the experience of several councils interviewed in this study.

An important matter for councils is the issue of guidance from state government on how to plan for climate change. By adhering to government policy and guidelines for managing the coast, a council would be protected from liability on the basis of having acted in good faith, and therefore not liable for impacts to private property due to coastal related hazards (McDonald, 2007; Lipman and Stokes, 2011).

4.3 Outline of Science Input in NSW Coastal Legislation

4.3.1 Coastal Protection Act (1979)

The analysis of the *Coastal Protection Act* identified three key provisions enabling the application of science to coastal management; the scientific advisory NSW Coastal Panel, strategic planning requirement at the local level through coastal zone management plans, and the provisions of the Act for the development assessment process.

NSW Coastal Panel

The Act was amended to establish the NSW Coastal Panel in 2010, an advisory panel consisting of the Chair, and six members nominated by local councils and state government agencies. The major function of the Coastal Panel is to provide advice on coastal matters referred to them by the Minister, including any issues to do with the coast, administration of the Act, and to provide advice to local councils. Furthermore, the legislation states that the nominated members on the Coastal Panel “must have qualifications and experience relevant to coastal planning, coastal engineering, coastal geomorphology, coastal environmental management or estuary management”, thus providing a legal mechanism for science informed coastal management through expert coastal knowledge. Specifically, some of the actions undertaken by the Coastal Panel include:

- An advisory role to the Coastal Ministerial Taskforce regarding the coastal management legislation reforms;
- Providing advice to the Minister regarding coastal erosion impacts and potential management strategies for erosion occurring at Kingscliff Beach in Tweed Shire Council¹;
- Reviewing local councils draft coastal zone management plans.

The Act also provides a legal mechanism for ensuring the Coastal Panel’s recommendations are applied to planning and management, stating that recommendations by the Coastal Panel regarding changes to a coastal zone management plan are to be incorporated into a plan and resubmitted for approval. A further role of the Coastal Panel made under the State Environmental Planning Policy (Infrastructure), is consent authority for coastal protection works on all land that does not have an approved coastal zone management plan. The Coastal Panel’s dual role as reviewer of coastal zone management plans and consent authority for land without a coastal zone management plan, provides a legal mechanism for a co-ordinated approach

¹ The Minister for the Environment requested advice from the NSW Coastal Panel with respect to the management of beach erosion at Kingscliff in the Tweed Shire Council local government area.

to the placement of new coastal protection works across the State. The *Coastal Protection Act 1979* also makes it possible for the Coastal Panel to be given development consent authority under the *NSW Environmental Planning & Assessment Act*. This provision has been implemented by the statutory State Environmental Planning Policy (Infrastructure), giving the Coastal Panel the role of consent authority for coastal protection works for all land that does not have an approved coastal zone management plan.

Coastal zone management plans (Part 4A)

The *Coastal Protection Act 1979* provides a framework for the preparation of coastal zone management plans (CZMPs) by local councils. CZMPs are not legally required by all councils, however by developing a CZMP in accordance with the Guidelines and managing their coastline accordingly, councils are protected from liability for their actions under section 733 of the *Local Government Act 1993*, if decisions are ‘made in good faith’.

The *Coastal Protection Act* creates a legal basis for the incorporation of science into CZMPs through two main mechanisms. First, the Act sets out various ‘Matters to be dealt with in a CZMP’ (CP Act, Part 4A, 55C), the following of which require scientific assessments undertaken by councils:

- The management of risks arising from coastal hazards;
- The management of estuary health and any risks to the estuary arising from coastal hazards;
- The impacts from climate change on risks arising from coastal hazards and on estuary health;
- Managing the impacts of proposed coastal protection work.

Second, the Act refers councils to adhere to the Minister’s Guidelines for Preparing Coastal Zone Management Plans. Though the guidelines are not a statutory document, all CZMPs are to be submitted to the Minister for approval; therefore councils must make a plan according to the guidelines. Through the guidelines more specific science requirements are applied to managing coasts. For example, in addressing estuary health, the guidelines detail what a CZMP is to contain, including:

- The estuaries' current health status;
- Matters affecting the estuaries health;
- A projection of climate change impacts;
- Proposed actions to reduce risks to the ecosystem;
- An entrance management policy for intermittently closed and open lakes and lagoons (ICOLLs);
- An estuarine monitoring program that is consistent with the NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy.

Use of the coastal zone (Part 3)

Development assessment in the coastal zone is influenced by the *Coastal Protection Act 1979*. The Act states that development consent authorities, whether local councils or the Minister, must not approve development or carry out development in the coastal zone that is “inconsistent with the principles of ecologically sustainable development” or which may adversely affect, or be affected by, the coastal environment or the sea.

Decisions based on the principles of ecologically sustainable development (ESD) have been found by the NSW Land & Environment Court to include climate change considerations (*Walker v Minister for Planning [2007] NSWLEC 741*). Though this decision was successfully appealed, the court stated climate change will likely become a presumed consideration of ESD, and failure to consider it will become strong evidence in court decisions (*Minister for Planning v Walker [2008] NSWCA22*).

4.3.2 Environmental Planning & Assessment Act (1979)

The analysis of the *Environmental Planning & Assessment Act 1979* identified three key provisions enabling the application of science to coastal management, including environmental planning instruments (EPIs), the process of development assessment, and requirements for environmental assessments.

Environmental Planning Instruments

One provision of the Act enabling evidence informed management of the coast is Environmental Planning Instruments (EPIs), including requirements for councils to have

a Local Environmental Plan (LEP) to guide local land use decisions and by granting power to the Governor to create State Environmental Planning Policies (SEPPs). Environmental planning instruments are created for various aims, with the major purpose of achieving State planning objectives.

An EPI can be used to address environmental management issues, with the legislation making provisions for EPIs to protect the environment. The Act makes specific reference to components of the environment including native animals and plants, threatened species, populations, ecological communities and their habitats, and vulnerable ecological communities (Part 3, 26). The Act also allows for EPIs to make provisions for development control by such means as development standards, providing a mechanism for controlling the type and placement of development on the coast.

At the local level, a council uses a Local Environmental Plan (LEP) to determine land zoning and associated development categories. The *Environmental Planning & Assessment Act 1979* gives power to the Minister to issue Ministerial directions with regard to requirements for a council's LEP. Directions have been issued under the Act that require councils to consider the NSW Coastal Policy (NSW Government, 1997) and the NSW Coastal Design Guidelines (NSW Government, 2003) in developing their LEP. The Policy and Guidelines are based on scientific understandings of the coast; therefore the legal provision of Ministerial Directions enables the application of science through a LEP. For example, the NSW Coastal Policy sets out the framework of goals and objectives for managing the coastal zone in the State and provides strategic actions for achieving these goals. The NSW Coastal Design Guidelines includes design principles and setback requirements that aim to minimise development impact on the coast and protect property. A further component of development control occurs through the use of Development Control Plans (DCPs). These are created by a council to achieve the objectives of the zone, and may address coastal zone development matters such as appropriate setback lines and development design, as informed by the NSW Coastal Design Guidelines.

State Environmental Planning Policies (SEPPs) are a means for the NSW government to achieve state planning objectives through a consistent approach to development planning. Science based requirements for controlling coastal development and its

impacts on coastal environments are provided through SEPPs. SEPPs are not ‘the law’, in the sense that they are not subject to parliamentary consideration or approval; however, they are developed by the Minister with power given by the EP&A Act. Councils are therefore required to consider SEPPs when assessing development applications. The major SEPPs applicable to the coast are:

- SEPP 71 Coastal Protection
- SEPP 14 Coastal Wetlands
- SEPP 26 Littoral Rainforests
- SEPP 50 Canal Estate Development
- SEPP Major Development
- SEPP Infrastructure

Development assessment

The Act sets out matters that must be considered in assessing a development application, among which include consideration to coastal environments and processes including any adopted local Coastal Zone Management Plan, environmental consideration, and the interest of the public which has been determined through NSW case law to include climate change risks.

Environmental assessment

The Act provides for environmental assessment requirements for development applications that are likely to have a significant environmental impact, aimed at protecting vulnerable habitats and species. An interesting point is the reference to cumulative impacts with regard to environmental assessment of fishing activities, with the Act stating “the environmental assessment is to assess the likely cumulative environmental impact of the designated fishing activity carried out by all the proponents as authorised by the applicable fishing regulatory controls described in the draft strategy (Part 5, Division 5).” The general absence of assessment of the cumulative impacts generated by preceding approved development has been criticised by Abel et al. (2011); they discuss how in the current system of development approvals, proposals are assessed solely on the criteria for the zone in which the proponent wishes to build. Land

use is not planned holistically but instead determined one development application at a time. Incorporating cumulative impact assessment with regard to development applications is a potential improvement that could be addressed by legislation.

4.4 Conclusion

All the actions taken by local councils in managing the coasts are done with guidance from the provisions of the legal and policy framework that applies to the coastal zone. Law and policy is therefore an important factor to achieve science-based coastal management. This chapter presented the results of this thesis' analysis of two key pieces of legislation that influence coastal management, the *Coastal Protection Act 1979* and the *Environmental Planning & Assessment Act 1979*. The analysis was performed to assess the mechanisms by which NSW coastal legislation enables the application of science to councils' coastal decision.

Chapter 5: Coastal Hazards and Climate Change

A key challenge of coastal management is addressing the risk of natural hazards and the impacts of climate change on the coast, responsibilities that are largely within the jurisdiction of local councils. The purpose of this chapter is to discuss local councils' role in management of natural hazards and climate change impacts, particularly how science and the law influence their actions and decision-making processes to address these issues. The significance of local councils' role in managing coastal hazards and climate change impacts, particularly coastal inundation and erosion, is reviewed in 5.1. Section 5.2 describes legal issues in NSW where the coastal management decisions made by local councils have been challenged in court by property owners. These cases illustrate the social issues involved in managing coastal hazard impacts, and the concern local councils have regarding liability for their decisions. In planning for sea level rise and coastal hazards, local councils negotiate various challenges related to scientific uncertainty, their legal responsibility for addressing risk, and social implications of management decisions; these planning issues are reviewed in section 5.3. The use of Coastal Zone Management Plans (CZMPs) by local councils in planning for coastal hazards and climate change, and legal barriers that have impacted councils' implementation of CZMPs is described in 5.4. This chapter presents the argument that a sound legal and policy framework is needed by local councils to address coastal hazard and climate change impacts on the coast. The law is particularly relevant in order to support councils' management approaches, as these approaches are often contentious and may be opposed from within the community and more broadly.

5.1 Managing the impacts of coastal processes and climate change

Natural hazards present a fundamental challenge for coastal managers worldwide. Of particular concern are risks of impacts to human settlements, including coastal floodplain inundation, receding shorelines, cliff erosion and periodic high energy storm events. The coastal zone is impacted by a range of physical processes within marine, terrestrial, fluvial and climate systems. Coastal planning and management decisions must take into account the complex environmental factors involved in ocean-land interactions and resulting impacts. Managing coastal risk is further complicated by expected climate change impacts on the coast, particularly the understanding that sea

level rise is occurring and will continue for many centuries to come (IPCC, 2013). The scientific uncertainty inherent in projections of timing and extent of sea level rise and coastline response presents a particular challenge for planning and management at the local level (Gurran et al., 2008). This section discusses key management issues occurring in coastal environments that local councils address through their work.

The IPCC has stated with very high confidence that coastal areas will increasingly experience inundation, or coastal flooding, due to relative sea level rise (Wong et al., 2014). The management implications for future conditions are most significant for coastal settlements where development currently exists or where pressure for new coastal development is high. There are two key elements of climate change projection that are particularly relevant to coastal inundation and councils' management of hazards. One element is gradual sea level rise from thermal expansion of the oceans and melting of continental icesheets. With higher sea levels, low lying land will be inundated when sea level exceeds land elevation, meaning some current land areas may be permanently inundated by the ocean. The second element is increased severity of extreme weather events causing inundation from storm surge and catchment flooding. Land in the coastal zone may be affected periodically during storm surges, when strong winds act to push water further inland than usual, and during large rainfall and river flow events. Storm surge and catchment flooding may occur as either separate events or in combination. The impact of extreme weather on coastal land will be affected by rising sea levels; land impacted by rising seas are also more susceptible to extreme events.

In NSW the risk of inundation with future sea level rise is a serious and potentially costly threat, as highlighted in the federal assessment *Climate Change Risks to Australia's Coast* (Commonwealth of Australia, 2009). Based on the 2007 IPCC sea level rise projections, the report states that NSW has between 40,800 and 62,400 homes estimated to be at risk of inundation with a 1.1 metre sea level rise and higher sea levels that would be associated with an extreme storm tide. The current replacement value for properties at risk of inundation in NSW is estimated to be between \$12.4 and \$18.7 billion (Commonwealth of Australia, 2009, pg. 77); the question of who will incur these costs is a major concern at the federal and state level (HoR, 2009).

Coastal inundation of low lying areas is a pertinent issue for the south coast of NSW where estuaries are a dominant feature. Estuaries in NSW are highly valued by local communities through their provision of a range of ecosystem services², and are under great pressure from human use including high development within catchments surrounding estuaries (NSW Government, 2013a). In NSW the majority of identified 'at risk' homes are located on coastal lakes, lagoons, estuaries or river banks, rather than along the coastal shoreline (Commonwealth of Australia, 2009). Managing existing development and future growth along coastal water bodies is highly relevant to the south coast of NSW, with each council area containing numerous estuaries, coastal lakes and lagoons. The state's southernmost coastal local government area, Bega Valley Shire Council, manages 29 estuaries which is 1/6 of all estuaries in NSW (Bega Valley Shire Council, 2014). Eurobodalla Shire Council manages five estuaries, including the Bateman's Bay Estuary at the mouth of the Clyde River, one of Australia's largest rivers (Eurobodalla Shire Council, 2015b). A significant feature of the south coast of NSW is the Shoalhaven River and its estuary, which is one of the 14 estuarine systems managed by the Shoalhaven City Council (Shoalhaven City Council, 2014). Wollongong City Council has numerous coastal creeks and lagoons, creating 14 estuarine systems that the council manages (Wollongong City Council, 2014). The estuary management concern on the south coast is illustrated by the following quote from the Environmental Service Coordinator for Bega Valley Shire Council:

One of our unique features is our 29 estuaries in the Shire. Most of those are quite small and vulnerable to human impact. But everyone wants to live near the water and have a water view. So I think managing those pressures into the future whilst keeping a good ecological health in those estuaries is going to be probably our biggest challenge down here (Bega Valley Shire Council, 29 November 2013).

Another management concern associated with sea level rise is erosion of coastal land. In sandy coastal systems, sediment movement occurs in response to the sea, particularly through the energy of waves, tides and major events such as storm surges and extreme runoff events. Sea level rise may result in shoreline recession depending on the physical

² "Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life," (Daily, 1997).

characteristics of the coast (Walsh et al., 2004). Shoreline recession becomes a management concern when development exists or is proposed adjacent to the coastline. The beach system is placed at risk by the presence of development inhibiting sediment movement and retention. The natural response of beach dune systems to sea level rise is to retreat as sediment is moved landward. However, where development exists adjacent to the coastline, the sediment has nowhere to go and therefore beach sand reserves on developed coastlines will potentially be lost with sea level rise (Wong et al., 2014). In NSW, coastal erosion impacts on near-shore development have been an issue of concern for many years. This issue is most pertinent in the central and northern regions of NSW where homes have been seriously damaged or lost due to coastal erosion. The concerns of individuals regarding erosion impacts on their property have led to legal conflicts over erosion management at locations in central and northern NSW. Dealing with the concern over coastal erosion in NSW has been a major focus of coastal management by the state government.

On the south coast of NSW, coastal inundation is of greater concern than erosion. This was expressed by representatives at Shoalhaven, Eurobodalla and Bega in particular. One example is the response given by the Coastal and Flood Planner at Eurobodalla Shire Council to the question about coastal issues of major concern in his local government. He stated:

Erosion wise we're not particularly bad, but inundation will have a major impact on us because we're pretty flat and most of it's built on old marine deposits (Eurobodalla Shire Council, 29 November 2013).

The predominant concern of coastal inundation over erosion was also discussed by the Natural Resources and Floodplain Manager at Shoalhaven City Council:

When you talk about coastal issues, a lot of people focus directly on coastal erosion. But when you look at Shoalhaven City Council for example, actually one of the biggest coastal issues in the future will be coastal inundation. And that tends to be forgotten by the political arena, but also by the community. So that's also a challenge in my view. Too much focus on the coastal erosion issues when the coastal inundation issues are also going to be very tricky to manage. And

we've already seen that as part of our flood studies (Shoalhaven City Council, 17 October 2013).

Research participants discussed how as coastal managers they are concerned with managing erosion and inundation risks. However when consulting with the community, councils on the south coast have found that people are very focused on the coastal erosion issue. Commonly people do not even accept there is an inundation risk that needs to be managed. The Natural Resources and Floodplain Manager felt that inundation of the low-lying areas around Shoalhaven's estuaries could become a prominent issue in the future, stating: "There could be some challenges in terms of what is there and how to sustainably manage these areas ongoing into the future. The question may arise – can people live there?" (Shoalhaven City Council, 17 October 2013).

There has been a strong focus on coastal erosion in NSW policy and legislation. For example, the state government identified 15 coastal erosion 'hot spots' in 2011 as priority areas to be managed (NSW Government, 2011). The identified hot spots illustrate how the majority of erosion issues in NSW currently occur in the central and northern regions. Only one of the hot spot locations occurs on the south coast, at Surfside Beach in Bateman's Bay in Eurobodalla Shire Council (Figure 2.1). Problem locations for coastal erosion are now identified as 'authorised locations' within the Code of Practice under the *Coastal Protection Act 1979*, replacing the term 'erosion hot spots'. Changes were made to the law to provide property owners at these locations special provisions for the use of coast protection works. In addition to the Surfside Beach at Bateman's Bay, Mollymook Beach in the Shoalhaven has been included as an authorised location. Other than these two locations however, coastal erosion is not currently a major concern on the south coast. In our discussion about the erosion issues at Bateman's Bay, the Coastal and Flood Planner from Eurobodalla Shire Council said they have had some ongoing cases of developments they had refused, however erosion is just part of the problem at this location:

The problem there will be inundation over time because it's all less than 2 metres AHD [Australian Height Datum]. We've applied a tidal analysis to determine when

we trigger consents for. So that will be the problem - eventually daily tides will get that area (Eurobodalla Shire Council, 29 November 2013).

Local councils have a key role in managing the risk of coastal hazard impacts on development in the coastal zone, particularly coastal inundation and coastal erosion. On the south coast of NSW coastal inundation is a more pertinent management concern, however the local community often does not accept that inundation is a risk. Inundation is a concern on the south coast because the region has many coastal lakes, lagoons and estuaries that are under pressure from development. If predicted changes to coastal systems occur, including sea level rise and changes to storm characteristics, many homes along coastal water bodies will be regularly impacted by inundation events (Commonwealth of Australia, 2009). The State has tended to give priority to coastal erosion in its coastal management program including NSW policy and legislative amendments. This focus by the State, and the resulting awareness within the community of erosion risks as opposed to inundation risks, is a challenge for councils.

5.2 NSW case law highlighting liability risk to councils in managing hazards

This section presents selected results from the thesis' case law analysis to highlight the potential legal issues councils may face. Summaries and discussion of several cases related to coastal hazards are given in this section. The case law analysis found that local councils have been involved in the majority of NSW Land and Environment Court (LEC) cases pertaining to coastal management issues as one of the parties. A total of 28 coastal management related cases in NSW were identified. The cases were about issues related to development appeals, third party challenge to development consent, unauthorised coastal protections works, and disputes over coastal land use and zoning; these categories point to the type of court cases councils may face in the future. Councils are the key authority to consent to development and land use in the coastal zone and are very concerned about their risk of liability for decisions regarding development and coastal hazards. It is important that councils' legal responsibilities are clarified, as cases involving councils are predicted to increase in the future (Baker & McKenzie, 2011).

In the central and northern regions of NSW where coastal erosion is a major management issue, several court cases pertaining to erosion risks to private development have been considered by the NSW Land and Environment Court. On the north coast, Byron Shire Council was involved in a legal dispute with property owners (*Byron Shire Council v Vaughan, Vaughan v Byron Shire Council* (2009) NSWLEC 88) following storm damage to a sandbag wall in 2009, initially built by council as a temporary solution to severe erosion. In this case, council did not intend to repair the wall and refused consent to the property owners to do so; this decision aligned with the council's policy of planned retreat in this hazardous location. Though eventually settled out of court, consent orders issued by the NSW LEC declared the protective structure, which was placed by council through their own development consent, was a right of the property and therefore Council was responsible for repairing and maintaining the protective wall.

Another court case regarding the use of coastal protection to protect private development involved Warringah Council in the northern beaches region of Sydney, NSW. This case regarded an illegally built sea wall by a property owner at Collaroy-Narrabeen Beach, built in response to an emergency erosion event (*Warringah Council V Franks & Ors* (1999) NSWLEC 65). The Council took the property owners to court to request the sea wall be removed. Engineering evidence indicated that the wall was not built to acceptable standards and may cause increased erosion risk to adjacent properties. In the court proceedings, contrary engineering evidence was provided to indicate the sea wall was soundly built and did not present a risk to beach erosion. The Court's decision was to reject the Council's application for demolition of the wall based on this engineering evidence.

These court cases demonstrate how in the work of local councils to manage coastal hazards, private development and the interests of individuals to protect their property is a factor that comes in to play. Several council representatives interviewed in this study expressed that the councils were concerned about liability for their actions regarding management of coastal hazards. In our discussion about the various social and governance influences on coastal decisions, the Environmental Strategy Officer at Wollongong described the councils point of view as a development consent authority:

Councils want to make sure they are not exposing themselves to any kind of liability by approving developments that might be subject to some sort of coastal hazard or risk in the future (Wollongong City Council, 24 September 2013).

Further to this comment, the Environmental Strategy Officer at Wollongong discussed how community views influence councils' coastal decisions, particularly the concerns of the individuals whose properties are impacted. In making coastal decisions, councils must consider the balance of social concerns and potential legal issues that may arise from their decisions:

It makes it very difficult to have an approach that is acceptable by all because you realize that it is not an exact science. We don't have all the answers, but we have to make decisions within that zone of uncertainty. So I guess the main thing is just use a risk-based approach. If there is a risk then you have to manage that risk (Wollongong City Council, 24 September 2013).

The risk of liability was discussed in the interview at Shoalhaven City Council. In response to my question, "Is liability a strong driver for decisions that are made by council?", the Natural Resources and Floodplain Manager replied, "Yes. Definitely", going on to explain:

And that's where the law is very important. In the Local Government Act, it's clearly identified that council has a duty to basically base its decisions on the best available information (Shoalhaven City Council, 17 October 2013).

Under the *NSW Local Government Act 1993*, section 733, councils are protected from liability if they have acted in good faith. This includes using the best available science in their planning decisions. The Coastal and Flood Planner from Eurobodalla Shire Council discussed how the liability protection provided by the *NSW Local Government Act 1993* is used to encourage the council to take an approach based on the science of coastal hazards and climate change:

At this council we needed to use that [liability] as a lever politically to encourage the right decisions to be made. It's been unfortunately something we've had to rely on; because if they go against our advice, our professional advice, it will come

down to their decision. So we've dragged that out on numerous occasions actually. It's cut and paste in nearly every report I do now (Eurobodalla Shire Council, 29 November 2013).

Local councils are concerned about their risk of liability for development decisions. If a council approves a development and it is adversely affected by an extreme event, councils may face significant expense for protection of private property, and/or expensive litigation. The case law analysis results found that local councils have been highly involved in the coastal case law that has occurred in NSW to date. The majority of these cases relate to issues of erosion management for private property and development assessment decisions. The case law summaries highlighted that a key aspect of councils' liability risk relates to the council's management of coastal hazard impacts on private property.

5.3 Planning for sea level rise

Science and the law are each important components in addressing management of sea level rise. Scientific information is utilised by coastal managers to apply to planning, and the law provides guidance to managers on actions to be taken, including monitoring and reporting the effects and effectiveness of actions. This section discusses the application of science to sea level rise planning by local councils within the legal setting in NSW. The interview data is used to illustrate the experiences of south coast councils in planning for coastal hazards and climate change impacts on the coasts. The data highlights the specific issues and barriers councils face in making decisions that address the risks of coastal hazards and promote adaptable communities.

As the major decision makers about local land use and development in the coastal zone, local councils have legal obligations to plan for climate change impacts including future sea level rise conditions. These decisions are important to society, for minimising risks to human populations and development, and to environmental outcomes, as management may impact ecosystem health. Concern over councils' responsibilities in planning for climate change impacts is a key theme discussed by the council officers interviewed in this study. The interview questions (Appendix 2) did not specifically raise issues of climate change or adaptation. Rather, the focus on climate change was driven by the interviewees, indicating the importance of climate change to councils. A key

concern for councils, as an administrative body of government, is the question of what are their legal responsibilities in planning for climate change impacts. As stated by the Environmental Strategy Officer from Wollongong City Council:

Councils are very concerned from their point of view the legal implications of doing or not doing any work. Because council is basically a local planning authority, so they authorise development and they want to make sure they are not exposing themselves to any kind of liability by approving developments that might be subject to some sort of coastal hazard or risk in the future. And of course they have a duty of care as well to the community; to inform them of what might happen, what might arise in the future. Not only to the people that actually own the properties but the people that might be interested in buying properties in the coastal zone in the future (Wollongong City Council, 24 September 2013).

There are inherent uncertainties in the science of climate and other environmental change and understanding how coasts will respond to change. This presents a challenge for local councils, which have a legal responsibility to plan for the impacts of change on the coast and may be liable for their decisions. Science provides a tool for understanding potential futures; however science is not capable of determining what will occur with full certainty. Despite the uncertainty that always exists within science, understandings of climate change have progressed to provide a clear message that impacts will increasingly cause damage to property, costs to individuals, communities and governments, and risk to safety (IPCC, 2013). To manage these risks, an integral part of the planning challenge is working with the uncertainty inherent in the science of climate change and sea level rise. Scientific estimates of sea level rise are given as various possible scenarios, taking into account unknown variables such as future carbon emissions and the response of earth systems to warming, particularly thermal expansion of the oceans and melting of continental ice sheets (Walsh et al., 2004). It is up to decision makers to determine how potential scenarios will be interpreted into planning policies.

Further to the issue of uncertainty about future sea levels, is the uncertainty in determining how the coast will respond to a particular sea level rise scenario in terms of coastal recession. One method widely used to predict the impact sea level rise will have

on shoreline erosion is the Bruun Rule, developed in 1962. The Bruun Rule is based on the theory that if a beach profile is in a state of equilibrium, when sea level rises, sediment will be eroded from the beach and nearshore area of the profile and deposited offshore. Under this theoretical framework, erosion of a shoreline profile under a given sea level rise can be calculated by applying a mathematical equation. The Bruun rule has been highly criticised as an over simplistic model that does not capture the complexity of factors determining shoreline recession (Cooper and Pilkey, 2004; Pilkey et al., 1993; Woodroffe et al., 2012).

Cooper & Pilkey (2004) argue that the Bruun Rule should no longer be used, pointing out in their review of the use of the Bruun Rule that many scientists recognise the limitations of the method. In fact, the scientist who developed the Bruun Rule cautioned 20 years on from its first publication that, “the rule has sometimes been used rather indiscriminately without realizing its limitations. One should always remember that it is basically two-dimensional, but it is almost always applied three-dimensionally” (Bruun, 1983, pg. 78). The rule assumes the sand eroded from the beach is immediately transported offshore along a two-dimensional profile of the beach. Sediment transport within a beach system however, is more complicated than this model as sediment moves in various directions in three dimensions. Another criticism of the application of the Bruun Rule is that it is often used at the local scale despite its inability to provide reliable estimates at this scale (Ranasinghe et al., 2012). Cooper & Pilkey (2004) highlight how Bruun Rule estimates are regularly applied to coastal planning decisions without recognition of the limitations of the method, potentially leading to inappropriate planning decisions. However, the authors recognise that the Bruun Rule has endured because it “addresses a very important societal problem and there is no simple, viable quantitative alternative” (Cooper and Pilkey, 2004, pg. 166).

One of the interviewed council officers discussed the criticism from the community for Council’s use of the Bruun rule in developing their draft Coastal Zone Management Plan, stating:

The science gave us a challenge as well when we were developing the coastal zone management plan, in that we were still using the Bruun Rule and members from the community were very critical of that. So it would be nice to see the science

progressing and be able to give us some tools that are a little bit more accurate ... and a little bit more acceptable. The Brunn Rule was developed quite a few years back, and it seems strange that we are still using this rule. And, it's hard to back it up with the community because we know it has its flaws. It's unfortunate that there isn't more advice in that regard, and more tools developed that are a little bit more contemporary (Shoalhaven City Council, 17 October 2013).

In planning for sea level rise impacts on their community, councils must negotiate many factors. The law determines the requirements for how councils address sea level rise planning, and limits the actions councils are able to take within their work. Councils require scientific tools to apply to sea level rise planning, however the inherent uncertainty of coastal science is a contested issue within the community. The community is aware of limitations to the science, and of tools such as the Bruun Rule, and question management strategies based on these uncertainties. Councils however are legally required to manage the risk of coastal hazards to their community and have concern regarding liability for their decisions to allow coastal development that may be impacted in the future.

5.4 Coastal Zone Management Plans

Coastal development planning and environmental protection largely occur through the work of councils; as such, evaluating the processes at play within councils is important for understanding, planning and protecting coastal environments. This section discusses the use of Coastal Zone Management Plans (CZMPs) as key documents used by local councils in managing the coast, particularly management of coastal hazards and climate change. The example of Wollongong City Council is discussed in this section as an account of the issues and the process undertaken to develop a CZMP. The impact of legal reforms on the development of Wollongong City Council's draft CZMP is outlined in this section. The impact of changes to state policy on Wollongong's work provides an overview of recent legal and governance issues associated with CZMPs; these issues have also been experienced by other local councils and have acted as a barrier to improved coastal management outcomes in NSW.

A CZMP is an important tool for local councils to manage issues affecting the coast. The major purpose of developing a CZMP is to set out management actions to address issues

arising from interactions between coastal environments and the community of coastal users. CZMPs are important for “managing risks to public safety and built assets, pressures on coastal ecosystems, and community uses of the coastal zone,” as stated in the NSW Guidelines for Preparing Coastal Zone Management Plans (NSW Government, 2013b, pg. 1). Though CZMPs were not specifically designed as a climate change adaptation tool, as coastal policy has moved in the direction of managing climate change in recent decades, management of climate change impacts has become a major consideration within these plans.

When councils manage coastal issues in accordance with their approved CZMP, they have legal and scientific basis for their actions. A legal basis for decisions is an important factor for councils who will increasingly face liability for their coastal management decisions (Baker & McKenzie, 2011). Court cases will consider if councils have acted within the law and related policies and plans, and whether they have used the best available knowledge about coastal hazards and climate change.

Despite the importance of having a CZMP, the efforts of local councils to develop and obtain approval for a CZMP have been impeded by various legal and social barriers. One key issue related to this challenge relates to sea level rise planning benchmarks. Changes to state policy regarding planning benchmarks has had a strong impact on council processes to develop their CZMP, as will be illustrated below by the case of Wollongong City Council.

Wollongong City Council completed their coastal zone study in June 2010 as part of the process to develop a CZMP. Coastal studies within the CZMP process provide a scientific basis for understanding coastal hazards and projecting sea level rise impacts on a council’s coastline. In Wollongong’s study, coastal hazard lines were identified based on the NSW sea level rise planning benchmarks; these benchmarks were made mandatory for councils for the first time in 2009. Priority risk areas in Wollongong were then identified based on the likelihood of the hazard occurring and the consequence of the occurrence on the community; feedback from the community factored into the rating of the level of consequence. Once the hazard and risk assessments were complete, management options were then recommended within the draft CZMP, completed in January 2012. The draft plan was released to the public and council undertook a

community consultation process, including a series of community meetings in March 2012, which were attended as part of Stage Two of this thesis' methods (Appendix 1).

The work done by Wollongong City Council on their draft CZMP was subsequently impacted by changes made to NSW state coastal policy and legislation. In particular, the decision by the NSW government to remove the state-wide sea level rise planning benchmarks provided local councils with the power to determine their own benchmarks. The NSW state government commenced a review process of their coastal policy and legislation in 2012 due to concern over the sea level rise benchmarks, and other related coastal management matters (NSW Government, 2015b). This led to a multi-stage process of coastal management reforms carried out by the state government.

One action under Stage 1 Coastal Management Reforms was to request an assessment report of the science used in developing the NSW sea level rise planning benchmarks from the NSW Chief Scientist and Engineer (NSW Government, 2012). This report found that although the scientific basis in determining the benchmarks was adequate, several issues with the science and its use were also identified. In particular, local variability of coastline response to sea level rise makes it questionable whether applying one set of benchmarks along the coast is the best approach. The report stresses that climate science is rapidly changing and benchmarks should be continuously reviewed to incorporate new understandings of climate. Due to variation of sea level rise impacts along the coast of NSW, a key recommendation of the report states:

The NSW Government could look toward more regionally specific calculations that take into account specific sea level, topography, flood risk and other conditions along the NSW coast. This would allow factors such as probability of extreme events (e.g. severe storms and surges) and impacts to be incorporated into local planning (NSW Government, 2012, pg. 22).

Following the release of the report, the state-wide planning benchmarks were retracted by the NSW government, allowing local council to determine their own benchmarks. For councils such as Wollongong, who had completed hazard studies based on the cancelled sea level rise benchmarks, the removal of the benchmarks has impacted the progress of their draft CZMP. The work done was based on sea level rise benchmarks that were unpopular in the public due to scientific uncertainty and impact on private property.

With the benchmarks no longer required by the law, councils had to decide whether to use their draft CZMP or to start again. The councils in this study who had commenced their draft CZMPs - Wollongong, Shoalhaven and Eurobodalla – each decided not to adopt the benchmarks. This was due to their unpopularity with the public rather than indication of inaccuracy of the benchmarks. Wollongong has not determined new sea level rise planning benchmarks, and does not have an approved CZMP more than five years after commencing their hazard study. The council has focused on addressing coastal issues identified through the CZMP development process, particularly issues regarding dune vegetation.

The removal of state wide planning benchmarks left councils with less certainty about requirements for sea level rise planning. In the interview with the Environmental Strategy Officer at Wollongong City Council, I asked what was the most challenging issue in sustainably managing the coast; she replied:

Sea level rise and what the impact will be in the future and how to respond to those risks. Also now that those state-wide sea level rise benchmarks have been removed and councils have the flexibility to use their own regional values that are appropriate for their own regional areas, I think there is going to be a lot more community questions about what values you use, and what's appropriate and what's not. It's really challenging for councils now to come up with something, and then to defend that as well with the community (Wollongong City Council, 24 September 2013).

These comments reveal how in councils' work they deal with community concerns and questions regarding their approaches to managing the coast. It is important that councils have support from the State government policy and legislation not only to guide their decisions, but also to provide evidence to the community as to the reason for their actions.

In their work, local councils gain scientific knowledge about coastal hazards through their coastal studies and have associated legal responsibilities for using this knowledge. As part of the NSW coastal reforms, councils were no longer required by legislation to include hazard information on planning certificates of at risk properties, known as section 149 certificates. The Wollongong City Council officer spoke about how the

council obtained legal advice regarding their requirements after these changes to the law took place (Wollongong City Council, 24 September 2013). They were advised that once they held information about hazards, to meet their requirement of acting in good faith, they were required to make this information available to the public. Under the *Local Government Act 1993*, a local council is protected from liability for their decision if they have acted in good faith. Wollongong was advised that they had a legal obligation to use the information in their planning decisions, and to include hazard notations on the planning certificates of potentially affected properties. Therefore, although the reform process has removed the legal requirement for councils to include hazard information on planning certificates, councils have a legal responsibility to make this information known to the public and to use it in their planning decisions. Some local property owners, however, are not happy with Wollongong Council's decision not to remove the notations as the Environmental Strategy Officer reveals:

Those people who are affected are not happy about it. Even recently when we provided an update to council on where the reform process is up to and the implications for the actions that council's already taken there was community feedback that those notations should be removed; but council upheld the decision to retain them for now (Wollongong City Council, 24 September 2013).

At the local scale, councils deal directly with community and their concerns. There has been confusion and frustration about the legal responsibility of councils to include or not include hazard notations. All of the councils interviewed kept hazard notations on section 149 certificates upon legal advice, although doing so has been unpopular in the community. The controversy over hazard notations was covered in Wollongong's local newspaper, reporting a local property owner "claims the notices, placed on 3000 properties region-wide by the council in 2010, have tarnished their properties, making them unsellable, uninsurable and creating serious hitches with development," (Spillett, 2013). A challenging aspect of councils' work is to negotiate community concerns, such as these, about property interests; this challenge was discussed by the Natural Resources and Floodplain Manager at Shoalhaven City Council:

We talk about community consultation but we're not specialists in the area. It's hard not to only attract the vocal people that are looking a little bit more

personally at what will be the impact on them rather than embracing community values. So it's very hard for us to get to know what the community in general think about the issue. It's been challenging...the consultation process has been challenging (Shoalhaven City Council, 17 October 2013).

The challenge of community consultation was discussed at several points in the interview at Shoalhaven City Council. Both council representatives at the interview expressed that councils could use better social science tools to address coastal issues, particularly to gain community understanding and acceptance of management approaches. The Natural Resources and Floodplain Manager commented:

Social science, from my view, is missing from coastal management. The technical side of things, the coastal processes – we do have some tools. They're not perfect but they are there. But the other - social science - it is an interesting aspect that I don't think has been developed that much (Shoalhaven City Council, 17 October 2013).

Managing current and future risks of coastal processes impacting private development and public assets on the coast is a key purpose addressed in CZMPs. This role makes CZMPs an important tool for adapting to sea level rise and climate change impacts on the coast. Coastal management research points out that taking actions today to adapt to expected sea level rise is important to minimise the financial, social and environmental costs associated with major hazard events (IPCC, 2012). Local councils have a key role in climate change adaptation through their power to approve development in the coastal zone. The work of local councils to address climate change risks to the coasts has been impeded however by a lack of clear and consistent legal requirements.

5.5 Conclusion

Local councils have a key role in managing the impacts of coastal hazards and climate change on their communities. This chapter has discussed how on the south coast of NSW, coastal inundation is a key management issue with many estuaries under development pressure. There are many homes situated along estuary foreshores that are predicted to be at risk to periodic inundation with future sea level rise and increased

flooding. The interviews revealed that there is discord between the inundation management concern on the south coast and the State's management focus on coastal erosion. Multiple State policies and legislative amendments have been directed at managing erosion in NSW in recent years. A focus on coastal erosion is also evident in the media, with many articles detailing the impacts of coastal erosion on communities and individual property owners (ABC Radio Australia, 2010; ABC News, 2012; Spillett, 2013). Council representatives described in the interviews that the focus on erosion presents a barrier to managing inundation risk. Through their engagement, they have found that the community is very aware of the erosion risk but does not accept the risk of inundation.

Results from the case law analysis highlight legal issues that councils in NSW have encountered in managing the coasts. The cases presented occurred on the central and northern coasts of NSW where coastal erosion has had major impacts on private development. The interviews demonstrate councils' concern about liability for allowing development to occur that may be impacted by coastal hazards in the future. The concern for liability is a key influence on council decisions. Councils in NSW are legally protected from liability if they have acted in good faith; meeting this standard requires councils to apply the best available coastal science to their decisions. A key argument of this thesis is that councils need a legal framework to enable the application of science, thereby providing councils greater certainty in how to meet their obligations.

The chapter demonstrates how uncertainty in science presents a challenge to councils. It is difficult to determine an approach to managing coastal hazard risk that is accepted by the community and by local politicians. The community is aware of scientific uncertainty associated with projections of coastal change and are unwilling to accept restrictions on private development based on uncertain science. An important tool used by local councils in managing coastal hazards is Coastal Zone Management Plans (CZMPs). The processes undertaken by south coast councils to develop a draft CZMP highlight how the councils negotiated various factors in this process, particularly the concerns of the community and issues related to policy and legislative reform. The removal of the NSW sea level rise planning benchmarks has impacted the progress of these councils finalising draft CZMPs, to which they have allocated funding and resources for coastal studies and developing the plans. Removal of the benchmarks was

based on the assessment provided by the NSW Chief Scientist and Engineer who found the scientific basis was adequate, but that sea level rise planning could be improved by taking a regional approach that considers local conditions. When changes to the legislation allowed councils to determine their own benchmarks, the councils interviewed in this thesis decided not to adopt the former benchmarks although resources had been dedicated to developing draft CZMP's based on these benchmarks. This chapter has shown that these councils' decisions to reject the benchmarks were largely influenced by unpopularity with the public and public perceptions regarding climate change. This thesis suggests there is a need for more discussion regarding how to deal with scientific uncertainty in coastal planning and the application of the Precautionary Principle. In particular, this discussion needs to consider how to improve social science in coastal planning to better address public concerns.

Chapter 6: Science and Coastal Development

In recent decades the 'sea change' migration of people in Australia, described by Burnley and Murphy (2004), has led to rapid population growth in coastal communities, beyond the capital cities. Subsequently, there is high pressure for coastal development in NSW. Population growth generates associated pressure for further development to service the needs of these growing populations. This can lead to high competition for coastal properties, redevelopment pressure within existing communities, and demand for new development to occur on previously undeveloped sites. Local councils have a primary role in determining development outcomes as the primary consent authority. Applying a risk management approach, in order to reduce potential impacts of coastal hazards on development is discussed by councils as an essential component to managing the pressure for coastal development. Addressing risk in the coastal zone however, is complicated by socio-economic concerns regarding impacts on private property interests. Amongst other issues, councils are particularly concerned about negotiating competing demands of coastal hazard risk management and development pressure. This chapter examines how the law interacts with development issues in councils' work and whether the law acts to enable or inhibit decision-making based on the best available science. This chapter considers the socio-economic issues occurring in council areas regarding development, how these influence coastal management decisions and the use of science, and the legal issues regarding coastal development and local councils.

6.1 Relevance of Property and Development to Coastal Management

Managing development pressure in the coastal zone is a key concern for coastal management in Australia. This was made clear, for example, in the 2009 Australian parliament inquiry into climate change impacts on the coast, *Managing our coastal zone in a changing climate: The Time to Act is Now* (HoR, 2009). The report devoted a chapter to planning and legal matters, stating these concerns were "frequently raised by inquiry participants over the course of the inquiry, particularly in the context of projected climate change impacts on the coastal zone," (HoR, 2009, pg. 113). An explicit concern expressed by a number of submissions to the inquiry were related to how we plan for coastal development in light of expected climate change impacts on the coast.

Specifically, the report states, “There is a pressing need to reconsider how we plan for coastal development, the criteria we apply to approve or reject development applications and the building regulations imposed for new structures to safeguard against risks of sea effects on coastal assets,” (HoR, 2009, pg. 125). Local councils are key to development planning and assessment; they have the role of planning for local land use and as the primary authority to provide consent for development. The need to improve our approach to coastal development to manage the impacts of the sea is a primary concern of the local council officers interviewed in this study.

The use of science to identify locations that are likely to be impacted by coastal processes is essential to managing coastal hazard risks on development. The immediate and short term economic implications of risk association for identified properties, however, is often the basis of the concerns held by property owners and local government politicians. Coastal studies are used to assess sensitive coastal locations that may require additional measures to protect these habitats, and to assess areas where coastal hazards present a risk to property and development. The information gained through coastal studies is linked to land cover datasets by which properties and development can be identified that may be at risk of coastal impacts. To manage coastal hazard risks, councils may adopt development restrictions for properties that have been identified as locations at risk. The major aim of development restrictions in this situation is to reduce risk by controlling the design and placement of the development, based on scientific understandings of coastal processes. Although science is crucial to managing coastal risk, the issue for property owners often relates to concern of how planning decisions impact on their own interests. As part of Stage Two of the methodology in this thesis, community consultation meetings were attended for Wollongong City Councils draft Coastal Zone Management Plan held in March 2012 (Appendix 1). Many of the concerns put forth by individuals of the community related to management impacts on private property. In particular, concerns were raised over the development controls that would be implemented if the plan is passed; options in the plan regarding acquisition of properties; and concerns that identifying properties as at greater risk from coastal hazards has resulted in de-valuing property and inability of property owners to get insured. One community member asked:

Why, if so many options will not happen for so long, why do all these options need to be considered right now when it is only going to de-value properties?
(Wollongong Community Consultation, Bellambi, 8 March 2012).

When management decisions impact private development, the resulting socio-economic concerns act as a barrier to the application of science. This study found there has been limited acceptance by communities of coastal hazard science and the associated management strategies, leading to pressure on local politics regarding the coastal management approaches adopted by councils. In discussing community views about the risks associated with coastal change, the Natural Resources and Floodplain Manager from Shoalhaven City Council stated:

I guess it's difficult for the community to accept or understand even the existing risks. So when you start to drift into the future - the talk about 2100 planning horizon, you basically lose the community. Some understand, but most of them don't; or they refuse to protect themselves that far. They can't see the relevance of the questions of 2100 to them, right here and now (Shoalhaven City Council, 17 October 2013).

Later in the interview, the Natural Resources and Floodplain Manager from Shoalhaven City Council talked about updating their Development Control Plan (DCP) for coastal land, which she described as “the best tool we have in terms of managing risk; it's the one that has the most weight in terms of development” (Shoalhaven City Council, 17 October 2013). There was an ongoing review of the DCP to determine the controls that will be applied to development assessment in the coast. She discussed the various pressures that come in to play:

So it's ongoing you know - balancing either side and compromise and trying to balance the risk consideration with community, community feedback and concerns, and political concerns (Shoalhaven City Council, 17 October 2013).

Part of the concerns of communities relate to planning decisions made on the basis of future sea level rise projections; the uncertainty of climate change science is often the focus of these debates. These issues are fundamental to coastal management and have played out across NSW, and indeed at a national and international level. In council areas

under development pressure, social, economic and political drive for increased development has the potential to result in new development allowed in hazardous locations. Most councils have undertaken coastal hazard studies to identify locations that are at risk to coastal inundation and erosion. A barrier to the application of the science occurs when management strategies based on this information are not adopted by a council due to development pressure.

A council's approach to planning and development in the coastal zone is guided and limited by law and policy. If the law does not provide requirements to support councils in basing their planning and development decisions on coastal science, then councils are limited in the actions they can take. However councils are concerned about their liability for development decisions. The challenging situation local councils are facing with regard to climate change and development was described by the Executive Director of the National Sea Change Taskforce, Mr Alan Stokes, in his submission to the 2009 parliamentary climate change inquiry. He stated:

In many respects, councils are at a loss as to how to respond at the moment. What we are seeing is developments being approved right now that, if some of the projections coming out of the IPCC are proved correct, will be placed at risk in the future ... there are still properties being approved today which perhaps it would be prudent not to (HoR, 2009, pg. 144).

For locations with development pressure, there are drivers from the community and local politics for increased development in the coastal zone. Without the law to support councils to take a risk management approach, development placed in the coastal zone today may be impacted by coastal hazards in the future. When coastal hazards impact property and development there is an associated range of environmental, social, economic and legal impacts.

6.2 Property and Development Issues for NSW South Coast Councils

For local government areas with high existing development or with potential and pressure for new development, the risk to property value and assets is seen to be a key community and political concern. Social concerns regarding economic impacts of coastal management approaches can have substantial influence on whether science is

applied to coastal management decisions. For example, community non-acceptance of coastal hazard science and related management strategies influences local politics and whether councils adopt or reject particular strategies. This section explores the socio-economic influences occurring within each council area in relation to coastal development in order to understand the ways in which social issues influence the uptake of science. It describes the differing balance of issues experienced in council areas that are highly developed (Wollongong), addressing development pressure (Shoalhaven and Eurobodalla) and experiencing little current development pressure (Bega). In particular, the section discusses council officers' responses to the question posed in the interviews: 'What do you consider to be the major human or social influences on coastal decisions in your local government area?' Responses to this question provide a picture of the issues associated with development occurring in each area.

Engaging with the public and managing community concerns is a major component of councils' role in coastal management. The challenges of negotiating a range of community and political pressures related to the impact of adopted coastal management strategies on individual property were discussed in the interviews. Property and development concerns were expressed particularly by representatives of three of the four local government areas interviewed - Wollongong, Shoalhaven, and Eurobodalla. These areas are developed (Wollongong) or facing development pressure (Shoalhaven, Eurobodalla), therefore issues related to managing coastal environments and development are dominant factors. The coastal management issues impacting these communities have been brought to the forefront through these councils' processes of creating a draft Coastal Zone Management Plan (CZMP). The socio-economic concerns discussed by the council officers have largely been encountered during their community consultation processes through which coastal study outcomes and management outcomes are communicated to the public.

Councils under development pressure (Shoalhaven, Eurobodalla)

In Shoalhaven and Eurobodalla council areas there is high pressure for development; these areas are attractive to residents seeking a sea change lifestyle in non-metropolitan areas and are popular tourist destinations. The interviews revealed that the pressure

for development is a dominant factor in the coastal management decisions made in these council areas. A view within these communities is to promote development, whereas managing future risks of coastal hazards impacting private property was not seen to be the primary concern. The major focus on property concerns is illustrated by the views expressed by interviewed council officers at Shoalhaven and Eurobodalla councils. In our discussion about community and social influences in her council area, the Natural Resources and Floodplain Manager from Shoalhaven replied:

It is mainly the impact on property value that is one of the considerations of the community and councillors. The risk is a consideration, but it's more the impact of the risk on the value that is an issue for them (Shoalhaven City Council, 17 October 2013).

There has been great concern by coastal property owners around NSW that coastal hazard risk association will devalue their property. This has been a contentious social issue, particularly when NSW legislation made it mandatory that councils include details of projected climate change risks on property planning certificates. Councils were required to include notifications once they had completed their coastal hazard studies based on the NSW sea level rise planning benchmarks. The benchmarks were released in 2009 and to be used by all councils in the state. There was a public outcry by property owners about the ramifications of identifying properties to be at risk when the science of sea level rise is not certain. Addressing public concerns has been a matter of concern for both state government and local councils. For councils with pressure for development, the issue has been particularly pertinent.

The council officer from Eurobodalla Shire Council discussed how property value and economic risk are major social drivers in his local council area, similar to the views expressed by the representatives at Shoalhaven Shire Council. The pressure for development is both politically driven, with the council supporting development to promote the local economy, and community driven. In the interview, concern was expressed that the focus on economic value as opposed to managing the risk coastal hazards pose to development, acts as a constraint to coastal management and planning.

Since the time of the interviews, these councils jointly undertook a hazard study to determine sea level rise planning benchmarks. This study was undertaken after the

NSW state benchmarks were removed, leaving each council to determine their own. Due to the unpopularity of the benchmarks with the public, as opposed to inaccuracy, these councils decided not to use their former hazard studies based on the NSW benchmarks. The document, the *South Coast Regional Sea Level Rise Planning and Policy Response Framework* (Shoalhaven City Council and Eurobodalla Shire Council, 2014), reports the outcomes and recommendations of the joint hazard study.

Eurobodalla and Shoalhaven councils each decided against adopting the worst case sea level rise planning approach and instead voted to adopt the moderate scenario. This decision was against council staff recommendations. As reported in a local newspaper, opposition to the policy was the dominant view expressed by the community at the Council meeting, particularly because it was felt the policy “would decrease property values and have a negative effect on the local economy” (Barton, 2014). Many of the councillor comments reported in the newspaper article (Barton, 2014) reflected a pro-development attitude, with councillors generally in support of the moderate scenario. Several councillors were against the policy altogether and thought it was the cause of “a severe downturn in the shire” (Barton, 2014), and the cause of decreases in property value.

The views of the community and local politics are influential on the approaches taken by local government to manage the coast. Without a legal framework to support councils to take a cautious approach to development and planning, the decisions councils make will be more heavily influenced by development pressure.

Highly developed council (Wollongong)

The Wollongong City Council officer’s views on the major social influences in coastal management in the local government area illustrates how various interests are at play. It was discussed how there are numerous community points of view about what should occur in the coastal zone, however coastal property owners are particularly concerned about the level of uncertainty in sea level rise planning and the impact of council decision on their own interests. The council, on the other hand, has great concern regarding their duty of care to inform the community about coastal hazards and their risk of liability for approving developments that might be subject to a coastal hazard in

the future. A major interest of the council is to reduce the risk of liability by taking precautions in their approach to development matters. Related to this is a council's duty of care to the community, to inform property owners and potential buyers of what hazards might arise in the future.

Remote council with less development pressure (Bega)

The interview with the Environmental Service Coordinator of the southernmost coastal LGA in the state, Bega Valley Shire Council, provided a contrasting experience of the influence of development, highlighting the opportunity that exists for conserving coastal environments in less developed regions. The social influences on coastal decisions in Bega were not seen to be largely constrained by development concerns. The Environmental Service Coordinator stated:

We have the political realm here, but generally I don't think we have as much of an economic driver as councils further north in terms of development pressures. Here I think it's probably economic in terms of tourism, but there is a strong social sense of wanting to keep the values of the coast as they are at the moment – so that is, when it comes to public involvement in decision-making – their love of the coast and their values is a strong driver of decisions that are made (Bega Valley Shire Council, 29 November 2013).

It was discussed that managing population pressures on the environment into the future is a key issue. At the present time, the council area does not have some of the management issues seen in other locations, such as existing development right up to the dunes or high pressure for development. However, everyone wants to live near the estuaries and coast and with future population growth these environments will face increasing pressure. The importance of planning for population growth in more remote regions that have not yet experienced great pressure for development is discussed by key research undertaken by the National Sea Change Taskforce (Gurran et al., 2005). The research discusses how less developed coastal locations, often valued for their natural habitats, will face increasing pressure from new residents and tourists seeking more remote locations. "As impacts on biodiversity, habitat, and landscape values are most significant during the early stages of development within an area, it is particularly

important to manage processes of growth in these areas” (Gurran et al., 2005, pg. 6). In order to plan development in remote regions such as Bega Valley Shire Council, so that environmental values are protected and the risk of coastal hazards impacting development are minimised, a legal framework to enable sustainable and consistent planning is needed.

6.2.1 Public land in the coastal zone

In addition to their role in regulating development on private property, local councils are also responsible for managing council owned land and Crown land that has been delegated to council control by the NSW government. The *Crown Lands Act 1989* sets out provisions for council management of the Crown Estate which contains coastal land, including many beaches, estuaries and waterways, and all land below the Mean High Water Mark (MHWM). Management of council owned lands occurs under the provisions of the *Local Government Act 1993*. Under the Act, councils must classify land as operational or community land, and the further delegation of community land as natural areas, sportsgrounds, parks, areas of cultural significance, or general community use. Councils are required to create a plan of management for community lands, with categories providing a focus for management intent. Public ownership of coastal lands in NSW has been promoted through compulsory and voluntary land acquisition under the Coastal Lands Protection Scheme commencing in 1973 (NSW Government, 2015a). Lands identified as significant due to ecological or social values are acquired through the Scheme and incorporated into national parks and reserves. The Coastal Lands Protection Scheme has had an important role in preserving coastal land on the south coast enabling existing protected land parcels to be extended, and the creation of reserve areas such as the Eurobodalla National Park (Norman, 2000).

6.3 New and Existing Development - Key Development Issues and Barriers

The concerns and issues regarding coastal development are distinct for the current footprint of existing development as opposed to development on previously undeveloped land or ‘green field sites’. The view presented in the interviews is that existing development presents the key challenges for coastal management and local

councils. This section draws out the challenges in managing coastal hazards on existing development with regard to the legal framework. The interviews are used to highlight the significance of new and existing development issues in the work of local councils.

In NSW, as in many other coastal locations around the world, there are homes and other structures that are currently impacted by coastal erosion and inundation issues. In broad terms, the key problem related to existing development is that structures have been built in hazardous locations on the coast, creating issues that may put the properties, community safety and environmental values at risk. The influence of past development decisions in the work of councils was commented on by the Coastal and Flood Planner at Eurobodalla Shire Council officer, who stated:

The legacy issues are mainly where it's at. If you look at the hazard areas, the coast is pretty well full; so it's all those issues with the legacy of development - it's the gentrification, it's the re-development, the houses built 20 years ago when it really wasn't settled in law whether you had to consider coastal impacts (Eurobodalla Shire Council, 29 November 2013).

As this statement points out, one of the key problems with existing development is when it was built without consideration of coastal hazard impacts. In particular, much of the existing development on the coast was built at a time when coastal processes, such as changes to sea level over time, were less understood than today. The result for coastal management today is that current developments, or those likely to occur on existing properties, will raise hazard issues if sea level rise projections become reality. Coastal impacts on development are likely to increase with sea level rise and climate change impacts. In order to minimise future ramifications, planning for impacts on existing development is needed.

A key challenge to implementing management strategies for existing development is addressing the community's concerns about councils' decisions. The Coasts and Estuaries Officer at Shoalhaven City Council spoke about the bigger picture of managing coastal hazards and the perspective of private property owners, stating:

You have an urban interface placed at risk in the past, property owners today buying in good faith with aspiration for their development, and now being

required to recognise coastal hazards including flooding, and including future risks (Shoalhaven City Council, 17 October 2013).

As discussed in the previous section, managing social concerns is a key issue for councils in managing coastal hazard impacts on development. This is particularly the case when there are financial impacts or perceived financial impacts on property owners resulting from councils' adopted hazard management strategies.

For new development, options to manage coastal hazard risk can be implemented when councils assess development applications. With new development there is an opportunity to implement measures, such as building setbacks from the shoreline, building design conditions, or trigger consent conditions, each acting to reduce the risk of coastal hazard impacts on the development.

In managing coastal hazard impacts on existing private development, government does not generally have the power to intervene or require property owners to take actions to reduce the risk of coastal hazard impacts on their property or development. However when new development is proposed an opportunity exists within the approval process for councils to enforce controls on the development, which will promote adaptation to coastal conditions. Therefore, councils have power (and a legal responsibility) to manage coastal hazard impacts on new development.

Interviews revealed that councils' capacity to manage coastal hazard impacts on the existing footprint of development is tied to how councils consent to new development proposals for these properties. In development assessment councils implement controls to reduce the risk of coastal hazards and to reduce environmental impacts through measures contained within their Development Control Plans (DCPs). Councils' power in development approval using DCPs is at the heart of meeting their responsibility to manage coastal hazards: "development control plans – they're the best tool we have in terms of managing risk" (*Wollongong City Council, 24 September 2013*).

There are options that councils could potentially use to manage the risk of future coastal hazard impacts such as trigger consents and rolling easements. These options allow properties to be used until the risk is too great. Titus (1998, pg. 1313) speaks about rolling easements, stating: "A more narrowly tailored way to ensure that natural

shorelines survive rising sea level is simply to create a rule to guarantee this result.” The author describes implementation of rolling easements occurring through compulsory acquisition of land by government when a certain trigger is met. This may be achieved through statutory measures. Thom (2012) recommends potential legal solutions that could be implemented in Australia to maintain public ownership of beaches while allowing shorelines to migrate naturally as sea levels rise. Of particular interest to this thesis is the author’s following recommendation:

“...it is possible for each State to strengthen its own coastal legislation with clauses that give weight to the protection of beaches as transient (non-fixed) land in both planning and property law. This would require changes to property law to clarify any future uncertainty regarding land ownership and property boundaries as shorelines recede and land is threatened with inundation by the sea...” (Thom, 2012, pg. 39).

The interviews reveal that councils believe there is future uncertainty regarding land ownership and property boundaries as sea levels rise. This uncertainty in the law reduces their confidence in using trigger consents. The Coastal and Flood Planner at Eurobodalla Shire Council talked about how they have used trigger consents in at-risk areas to implement retreat when sea levels rise. This approach places conditions on the development consent that states a house will eventually have to be removed if a trigger, such as a specified sea level rise, is reached. Although trigger consents have been used in Eurobodalla, none have been implemented there yet. Concern over the lack of legal precedence regarding enacting trigger consents was expressed in the interview: “The major impediment I think is the uncertainty around how a retreat trigger will be imposed” (*Eurobodalla Shire council, 29 November 2013*). The Coastal and Flood Planner felt that property law issues, particularly not having property boundaries fixed to high water in at-risk areas, is a major constraint to maintaining beaches for public use. This is an issue that he expects will arise on the south coast in the future.

Determining the best development control strategies to manage the risk of future coastal hazard impacts on existing development is a challenge felt by councils. In the interview with the Shoalhaven City Council representatives, the Coasts and Estuaries Officer described the challenge: “the dilemma now is, what weighting do you place on

those development rights as our knowledge of natural hazards is improving with the science?” (Shoalhaven City Council, 17 October 2013). In councils’ decisions about development and planning, they must consider the aspirations property owners have for using their land against the risks involved with allowing a development to occur. It was felt that although more accurate assessments of future impacts are being achieved by coastal science, the development rights associated with private property presented a barrier to managing coastal hazards.

6.4 Property Rights Issue

Councils’ work to manage the risk of coastal hazard impacts on private property is influenced by issues related to private property rights and private property boundaries. A great deal of coastal and estuary foreshore land is privately owned in Australia and therefore subject to the rights afforded to property owners for use of their land. One issue is that many existing homes on coastal and estuary foreshore land are at risk to future impacts of coastal processes, or are currently impacted; managing these risks is a concern of local councils. In managing coastal hazard risks the rights of private property owners, including issues associated with shoreward property boundaries, may inhibit councils from applying the best available science about the coast. The inability of councils to manage the coast in accordance with knowledge about coastal systems may result in destruction of coastal habitats and the loss of beaches, which has ongoing social and environmental impacts. This section discusses the significance of private ownership of land along coastal and estuary foreshores to coastal management, particularly how private ownership influences council decisions and may act as a barrier to the conservation and protection of coastal environments.

One property issue relates to the shoreward boundary of private property along coastal and estuary foreshores. After European settlement of Australia, land was transferred from the Crown to private ownership with differing methods used to determine property boundaries. For the most part, coastal foreshores and the seabed have been reserved as Crown land for public use (Thom, 2003). A key issue in light of sea level rise, is whether private property boundaries adjacent to coastal foreshores are fixed or ambulatory boundaries. When a property boundary is fixed, if the sea level rises the coastal shoreline becomes private property and the public no longer has free access to the coastline. Whereas an ambulatory boundary is related to the properties of the sea,

usually to mean high water level. If sea level rises, the boundary rolls back, thus maintaining public access to the coastline. This option has negative implications for the property owners whose land will be lost over time. In the debate over property rights, part of the challenge is balancing the rights of coastal land owners and the rights of the community to access the coastline.

Another property issue that influences how coasts are managed is existing use rights. Under the property law system in Australia, property owners have the right to use their land in accordance with previous use of that land. An existing use is defined in the *Environmental Planning & Assessment Act 1979* as “a use that is lawfully commenced but subsequently becomes a prohibited use under a new local environmental plan (LEP) or other environmental planning instrument (EPI)” (NSW Government - Department of Planning & Environment, 2014). The implication of existing use rights for council management of coastal hazard risk to development is that their power to manage coastal land use is limited. Even if the science indicates a location is sensitive and should be protected, or this location will soon be impacted by coastal hazards, existing use provides for continuation of previous rights. If land is re-zoned to reduce development impact in the coastal zone, the previously existing development retains use rights or just compensation if those rights are reduced or removed. This has implications for long term management of coastal development, as with sea level rise more developments will be placed at risk. The Coasts and Climate Change Council has recommended that existing use rights need to be reconsidered. In their advice to the federal government, the Council stated: “The legal concept of 'existing use rights' protects current land use from any new restrictions and limits the ability of governments to re-zone land to restrict the intensity of development in areas at future risk...These legal provisions pose a significant barrier to adaptation” (Australian Government, 2011).

6.5 Conclusion

The Australian federal government has recognised that there is a need to adjust the way we approach development in the coastal zone in light of predicted climate change impacts. Local councils have an important role in determining development outcomes as they are the key decision makers about local land use and development. The interviews with local councils discussed in this chapter highlight key development issues faced by local councils. In particular, private property interests challenge effective

implementation of management strategies based on current scientific understandings of potential coastal change. Property owners frequently oppose management approaches that impact on their development interests. These views influence local politics and contribute to determining the policies adopted by a council. The law has an important role in overcoming community and political pressure for continued development that does not consider coastal hazards or environmental impacts of development. Councils are guided and limited by the law; if a council's basis for refusing a development application reflects current science but does not align with the law, the council's decision can be overturned by a Court decision. The law should enable councils to base development decisions on what science tells us about future conditions by providing clear and consistent guidance on addressing the risk of coastal hazards on development.

Chapter 7: Conclusion

This thesis has investigated the role of local councils on the south coast of NSW in coastal management, in order to understand the legal, scientific and social challenges impacting their work. Dominant concerns in the work of local councils involve managing coastal hazard impacts on development and risks associated with predicted future changes to coastal environments. The work of councils to address development and coastal hazard issues is challenged by legal and policy frameworks, the application of science to coastal management, and complex socio-economic issues occurring within their communities. This chapter discusses key barriers to coastal management and potential changes to the legal framework needed to address these barriers.

7.1 Balancing concerns of inundation and erosion

On the south coast of NSW, coastal inundation risk is a particular management concern to councils. South coast council areas contain many estuaries with development and pressure for development along the foreshores. The council representatives interviewed are concerned that managing the risk of inundation impacts on these settlements into the future is going to be a major challenge. In order to manage the risk, controls on development are needed to minimise future impacts. Public acceptance is a necessary component of implementing coastal policy and management actions such as these (Stocker et al 2012). However, community acceptance of the significance of inundation risk is lacking on the south coast, and has been a barrier for councils implementing risk management strategies.

In the study area, there is broad community acceptance of coastal erosion risk but a relative lack of acceptance and knowledge of inundation risk. Council staff felt the attention given to erosion by NSW coastal policy and legislation, combined with media attention on stories of severe erosion in the state, has created a public focus on erosion risk. The focus in NSW policy and law on managing issues related to coastal erosion, and the social awareness of erosion issues in NSW, is illustrated by several examples. Key aspects of amendments to the *NSW Coastal Protection Act 1979 (CP Act 1979)* in 2010 and 2013 addressed issues related to property owners' legal rights and responsibilities for using coastal protection works to protect private property. The NSW government first targeted priority erosion management areas by listing coastal erosion hot spots in

2011; these are now known as authorized locations. The impacts of erosion on communities and individual property owners, particularly in locations experiencing severe issues, have been extensively covered in the media. This has created a public awareness of erosion risks. Media stories have reported on issues related to the rights of individuals to protect their property and the responsibilities of local councils to manage coastal erosion. Several erosion cases eventuated into legal disputes between property owners and local councils regarding responsibilities for structures to manage erosion (Warringah Council V Franks & Ors [1999] NSWLEC 65; Parkes v Byron Shire Council [2003] NSWLEC 104; Byron Shire Council v Vaughan, Vaughan v Byron Shire Council [2009] NSWLEC 88). Local communities on the south coast are aware of the potential risks posed by erosion to development, and therefore focus on coastal erosion and related management strategies.

The focus on erosion by the state government and media has created public awareness of the threats posed by erosion, and a focus on managing these issues. But this has come at the expense of public awareness of coastal inundation. Further, the emphasis of NSW policy and law on coastal erosion has come to present a legal barrier to councils' management of coastal inundation, which is of greater concern for coastal managers on the south coast of NSW.

7.2 Social science to address social issues in coastal management

South coast councils view managing the risk of coastal hazards and climate change impacts on existing development to be a key challenge in their role as coastal managers. In particular, councils are challenged by complex socio-economic factors that influence coastal management outcomes. Council representatives felt that current coastal science is sufficient to manage the risks to coastal settlements, despite some issues with the uncertainty in science. Addressing the broad range of social concerns and impacts on coastal management, however, is a major challenge for local councils. Council officers talked about how it is difficult for councils to get a clear picture of what the community as a whole wants for the coast. The individuals with concerns about impacts on their own interests and properties are generally the most vocal and create the major social drive that influences councils' work. Although these voices should be taken into account in coastal decision making, the desires and interests of the wider community are relatively unheard. Development on the coast impacts environmental values and may

have social consequences such as loss of beaches, loss of public access to the coast and disproportionate allocation of council resources to protection of high risk, high value coastal properties.

The lack of tools to address complex social issues that are part of coastal management was identified as a barrier by council representatives interviewed in this study. In particular the interviews identified a need for better social science tools to enable councils to address the challenging aspects of social concerns of coastal hazard science implications for private property. As the principal authority responsible for interacting with the community on managing coastal issues at the local scale, councils negotiate the diverse concerns and points of view coming from the community. The council staff involved in managing coasts and estuaries are responsible for sharing information about coastal issues with the community, receiving community feedback and negotiating community concerns. This task was discussed in the interviews as a challenging aspect of councils' role in coastal management, particularly in relation to coastal management issues that have created controversy in coastal communities throughout NSW's coastal zone. Key controversies relate to sea level rise planning and the impact of planning decisions on private property.

7.3 Remote regions - an opportunity to avoid problems in the future

Planning for future development pressure in remote coastal locations should be a key concern of NSW planning laws. In less developed regions there is an opportunity to avoid some of the development issues currently impacting more populated coastlines. This thesis has illustrated some of the legal, scientific and socio-economic challenges to councils in managing coastal hazard and climate change impacts on existing development in the coastal zone. Adapting existing development to coastal changes involves high costs that may negatively impact environmental values, the interests of property owners, and the broader community. These costs can be avoided through better planning so the development approved today is less likely to contribute to disputes in the future. Better planning is particularly important to protect and conserve Australian biodiversity and coastal amenity in remote regions which are often less disturbed than more developed regions and support diverse habitats and species of native plants and animals.

This thesis considered four councils along a spectrum of development and population pressure. The most remote council, Bega Valley Shire Council, is currently experiencing low development and population pressure. The interview with the Environmental Service Coordinator at Bega revealed that the council area does not currently have major issues associated with existing development on coastal dunes and pressures for new development. This differs greatly from the situations in Eurobodalla and Shoalhaven, where they are experiencing population growth and high development pressure. The council representatives at Eurobodalla and Shoalhaven discussed the complex community and political pressures for development occurring in their council areas. The community and political push for fewer restrictions on development has been a barrier for these councils to implement strategies to manage future risks of coastal hazard impacts.

This study suggests that the development pressure and related socio-economic issues occurring in Shoalhaven City Council and Eurobodalla Shire Council indicate the type of pressure that remote coastal regions, such as Bega Valley Shire Council, will likely face with future population growth. It is important that law and policy enable land use planning and development consent decisions to avoid risk to development and future costs associated with coastal adaptation. The costs of adapting to environmental change on the coast are high when there is an existing footprint of development. Locations with high development exposed to coastal hazards will require coastal protection in order for development to remain. Coastal protection is expensive and there are environmental and social costs associated with the potential impacts of a built structure on coastal ecosystems and on the supply of sand to beaches. Abel et al. (2011) argue that when a location experiences population growth and property value increases, the pressure on governments to build coastal protection will also increase. International examples support their argument that “governments will be increasingly likely to succumb to political pressure from residents and build sea defences regardless of net public benefit” (Abel et al., 2011, pg 283). Adapting to climate change risks by planned retreat involves great costs in order to compensate coastal property owners through buy-back or relocation programs.

Future development issues in remote regions may be avoided by planning development in accordance with scientific projections about future sea level conditions. There is a strong focus in the law to manage the issues that are currently occurring on highly

developed coastlines. The law also needs to address protecting remote areas by enabling strategic planning to avoid development controversies in the future.

7.4 Greater legal certainty for adaptation approaches

The law is considered by councils to be a barrier to development consent approaches that enable future coastal retreat rather than long-term protection of beaches with built structures. According to the council representatives interviewed, there is uncertainty whether their decisions to use climate change adaptation approaches, such as trigger consents and rolling easements, will be upheld in the future by the courts. Yet the legal community recommends these for overcoming uncertainty in the timing of sea level rise (Titus, 1998; Thom, 2012; O'Donnell and Gates, 2013). Existing development is allowed to remain on a coastal property until the risk of coastal hazard impacts makes it unsafe to stay. Once a hazard trigger is met, or the development can no longer be accommodated on the property, the land is transferred to public ownership thus enabling shoreline retreat. Consent to new development proposals for existing properties presents an important opportunity for implementing climate change adaptation because governments cannot retrospectively impose planning standards on private property (Bell et al., 2013). Interviews reflected concerns that the law did not support councils to use trigger consents and rolling easements and that consequent uncertainty makes them risky options for adaptation. A concern is that when a home is required to be removed because a hazard trigger is reached, the restrictions could be successfully contested making council liable to property owners for coastal protection. Trigger consents have been used by Eurobodalla Shire Council, but none have yet been implemented. O'Donnell & Gates (2013) argue that a clear legal framework to support their use is needed in order for these adaptation approaches to be successfully applied to coastal planning. It is recommended that State legislation should be evaluated in order to create legal certainty for councils to use these options.

7.5 Legal barriers to climate change adaptation

Legislation and court decisions have established that local councils must consider current scientific understandings of future climate change impacts on the coast when consenting to new development. However, requirements for climate change consideration are unclear in the current legal framework. This creates financial risk and

doubt for local councils over how to address scientific uncertainty in coastal planning. This is a particular concern for councils with a low rate base who cannot afford the financial consequence of loss in a major challenge from a wealthy developer or property owner. The coastal literature, and technical meetings and conferences attended as part of this research project, point to great concern that the current framework is inadequate for development planning for climate change (HoR, 2009; Lipman and Stokes, 2011; Hussey et al., 2013).

There has been a slow response in Australian laws for requiring coastal development proposals to be assessed with consideration to climate change (Eland and Millner, 2009). The climate change requirements that do exist occur predominantly through policy, including NSW State mandated policy and subsequent local policy such as Local Environment Plans (Sydney Coastal Councils Group & NSW Environmental Defenders Office, 2008). However, Commonwealth and NSW legislation and regulations, which are the only instruments with true legal standing, do not explicitly outline requirements for planning for climate change. Current legislation contains climate change as one of many matters, including social and economic issues, to be given mandatory considerations by the consent authority. However, clear guidance is not provided on the weightings to be given to climate change or other mandatory considerations in development decisions. O'Donnell & Gates (2013) argue that including climate change as a mandatory consideration does little to stop development in vulnerable locations. The issue is that there is no legal requirement for development approvals to be based on the implications of climate change, provided the council can show climate change has been considered (Ghanem and Ruddock, 2011; O'Donnell and Gates, 2013).

The lack of statutory force creates challenges for councils in their implementation of climate change adaptation policies. O'Donnell & Gates (2013) discuss this issue with regards to the now cancelled NSW Sea Level Rise Policy (2009) and the NSW Coastal Planning Guideline (2010), in which communities opposed local councils' actions to implement these policies. The authors state: "because these policies lacked statutory force, they provided inadequate State government support for coastal councils attempting to undertake adaptation, subjecting them to potential legal actions or liability from developers and residents concerned about planning controls and insurance risks" (O'Donnell and Gates, 2013, pg. 224).

Eland & Millner (2009) discuss how the courts have played a role in requiring coastal planning to apply climate change science, warning that: “Absent a clear expression of the intention of the legislature to address and consider climate change impacts, the courts and case law cannot be relied upon to ensure these impacts are taken into account (pg. 26).” Court decisions regarding climate change have been inconsistent, attributed by Eland & Millner (2009) to planning laws providing insufficient guidance on incorporating scientific understandings of climate change. This creates uncertainty for councils in implementing climate change policy and for courts in interpreting the law.

A sound legal and policy framework is needed for local councils to address coastal hazard and climate change impacts on the coast. There have been many recent changes to NSW coastal law and policy, particularly regarding sea level rise planning. The lack of clear and consistent guidance has impacted councils’ work and has created uncertainty and a sense of frustration. At the time of this research, councils expressed that they did not feel they were equipped to determine their own benchmarks. It was felt the lack of guidance from the state on sea level rise planning left them open to criticism from the community.

7.6 Conclusion

The way in which new development on the coast is approved has a profound effect on the function and health of coastal environments. Managing coastal development is a current issue because the coasts of Australia are under great pressure from development and increasing populations. Scientific projections about future conditions on the coast indicate coastal development will increasingly be at risk to coastal hazards. In order to protect and conserve coastal habitats into the future, and secure coastal developments, it is imperative that development planning and approval uses best current scientific understandings of coasts and their response to environmental and human change. Local councils are the key decision makers about land use and development in the coastal zone. In their role as coastal decision makers, councils negotiate competing demands; they have statutory responsibilities to protect the coast, however there is social and political pressure for increasing development intensity, which may compromise the health of coastal environments. Local councils have a challenging role in managing development pressure on the coast, particularly because they need to reduce the risk of future climate change impacts while addressing the

rights and concerns of property owners on the coast. Further concerns of councils relate to meeting their legal obligations in their decisions which may be challenged in the courts. To meet these challenges, and to reduce future litigation, councils need a strong legal framework that enables decisions based on current scientific understandings of the coast.

Managing the risk of coastal hazard and climate change impacts on the coast cannot be addressed by science and the law alone, however. Public opinion regarding coastal hazards and climate change are influential on the management approaches adopted by local and state government. The analysis of interviews, literature and law presented in this thesis indicate property owners and developers with vested interests in coastal properties are apprehensive about the development restrictions used by councils to manage future climate change risks. Scientific uncertainty is key in this debate as public understanding of scientific uncertainty is poor, and the public often does not accept development restrictions based on uncertain science. Even as our understanding of climate change improves, it is possible that the science will not achieve a level of certainty that will convince the public to accept restrictions. This thesis suggests that greater dialogue is needed regarding how to address scientific uncertainty in decision-making.

When development is impacted by coastal hazards, private property owners may seek protection of their property, as has been seen in Australian court cases. In light of predicted climate change impacts, the literature predicts council decisions regarding coastal management approaches will increasingly be contested in the future. The decisions regarding whether to use coastal protection structures impacts more than the individual property owner, as protection of individual properties can come at a cost to the environment and the community. The council representatives interviewed in this thesis indicate that the portion of the community who is vocal regarding coastal decisions are largely those with private interests in the coastal zone. To protect coastal resources for the community as a whole there is a need for improved social science tools to address a range of socio-economic concerns, along with discussion regarding distribution of public costs for private benefit.

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Appendix 1: Stage Two of the research methodology involved attending various events to gain an understanding of key issues within coastal management pertaining to law and science. This method also enabled researcher acquaintance with a network of coastal professionals, including staff from local councils on the south coast of NSW.

Event	Event Type	Location	Date	Year
Southern Rivers CMA Coast & Marine Working Group	Coastal Professionals Meeting – CSIRO Coastal Collaboration presentation by Richard Kenchington and project discussion with group	Batemans Bay, NSW	September 13	2011
Climate Change and Coastal Communities: Law and Governance Issues	Public Seminar and Panel Discussion	Clayton Utz, Bligh Street Sydney, NSW	September 15	2011
Illawarra Natural Resource Management Reference Group	Coastal Professionals Meeting	Wollongong City Council Building	February 29	2012
Wollongong draft CZMP	Community Consultation Meetings	Wollongong, Thirroul, Bellambi	March 8-10	2012
Strategies to overcome cross-scale barriers to local government climate change adaptation	Workshop for Local, State and Federal government and non-government representatives	Institute for Sustainable Futures (ISF) - University of Technology Sydney, NSW	April 3	2012
Southern Councils Group	Workshop for south coast councils staff facilitated by the CSIRO Coastal Collaboration Cluster; Presentation of Cluster project including thesis' legal findings, followed by discussion	Ulladulla, NSW	May 7	2012
Barriers to Effective Climate Change Adaptation - Productivity Commission Inquiry	Public Hearing held by the Productivity Commission	Adina Apartments Surry Hills, Sydney, NSW	July 10	2012
Coast to Coast 2012	Australian national conference for coastal scientists and managers	Brisbane, QLD	September 17-21	2012
NSW Coastal Conference 2012	NSW state conference for coastal scientists and managers	Kiama, NSW	November 7-9	2012
NSW Coastal Conference 2013	NSW state conference for coastal scientists and managers	Port Macquarie, NSW	November 12-15	2013
Coast and Marine Working Group - SE Local Land Services	Coastal Professionals Meeting	Batemans Bay, NSW	February 4	2014
NSW Coastal Conference 2014	NSW state conference for coastal scientists and managers	Ulladulla, NSW	November 11-14	2014

Appendix 2: Interview guide for semi-structured interviews with representatives from NSW south coast councils.

Coastal Management

- Could you please explain your role?
- What do you consider to be the major human or social influences on coastal decisions?
 - e.g. community, individuals, government (State, Cwth), governance relationships, particular issues, etc.
- What do you think are the most challenging issues in sustainable management of the coast in your LGA?
- Are there any coastal issues of major concern in your LGA?
- Are there any locations in your council area where coastal erosion is a major concern?
 - Infrastructure or development at risk?
 - Are there any barriers (scientific, legal, governance or other) that are impeding management of the issue?

Science

- What role do you think science plays in coastal management?
- In your job, how important is it to have a scientific understanding of coastal processes?
- What are your main sources of scientific information?
 - e.g. commissioned studies (consultants), State or Cwth government or departments (CSIRO), scientific journals

Law

- In your daily practice, is there a need to consider and interpret the law as it applies to the coast?
- Are there any major legislative issues that impede best practice in NSW coastal management?

Law and Science

- Can you think of a particular case in your council area where there has been a discrepancy between the law and science? – e.g. Where perhaps the law has directed you to make a decision which was not based on the best science; or where you were restricted by the law to apply the best science?
- How did you reconcile the discrepancy?
- If you were to identify a discrepancy between science and the law in your work, are there any opportunities for this experience and knowledge to be fed back into the law? – i.e. Are there any feedback loops between coastal managers and the law?